14 APRIL 1960

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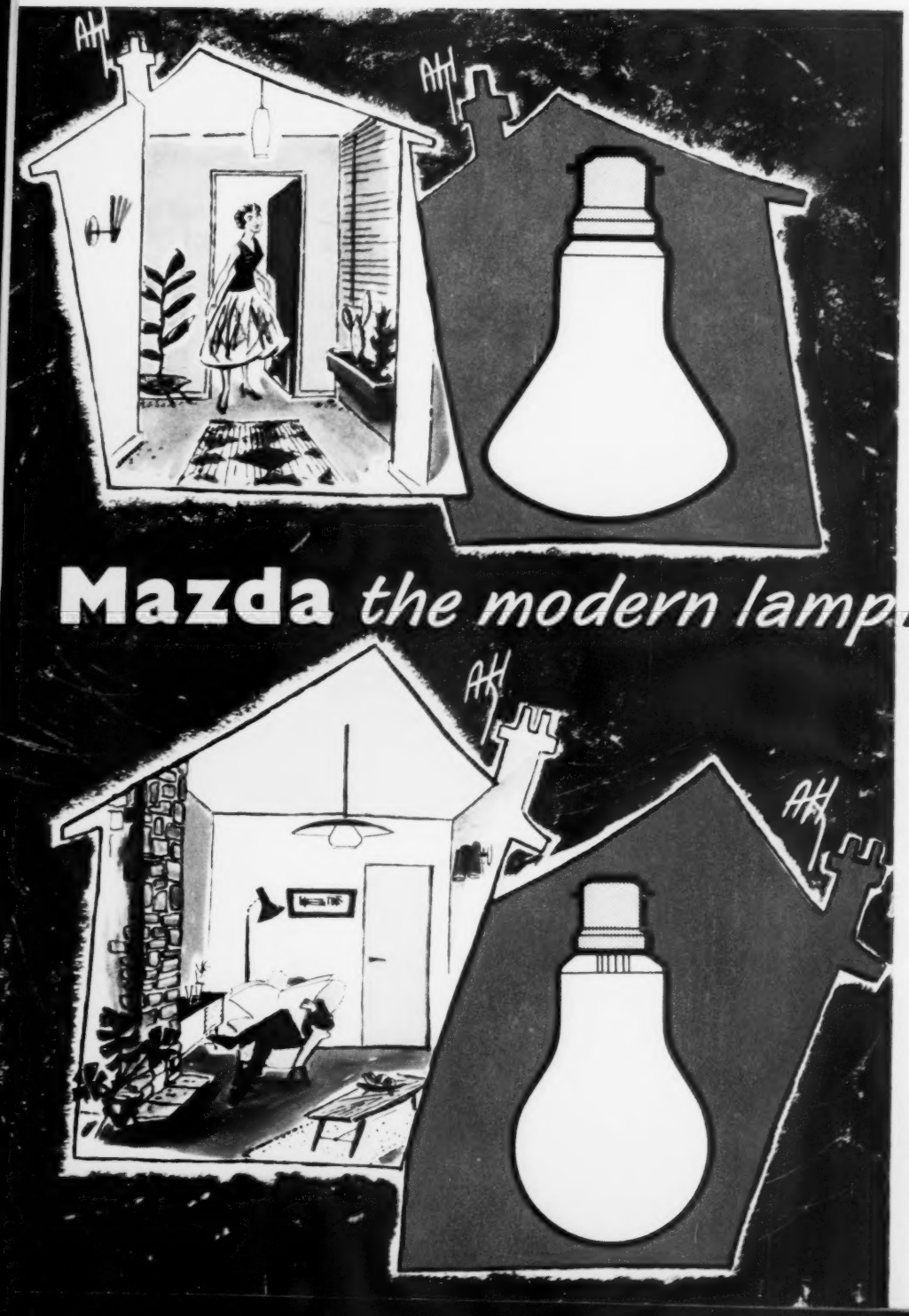
ELECTRICAL TIMES



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The reliable Mazda GLS lamp has been completely restyled to meet the demands of the modern home. Result: the NETABULB. Netabulbs retain all the proven qualities of the ordinary Mazda lamps, but are more pleasing and compact in shape, and provide the advantages of coiled-coil filaments and Silverlight finish.

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7. Screws have domed ends — cannot cut into cables.
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Wylex Distribution Boards
contemporary to the range of Switch Fuse Control Units available in 4, 6 and 8 way. All-Insulated and Metalclad.

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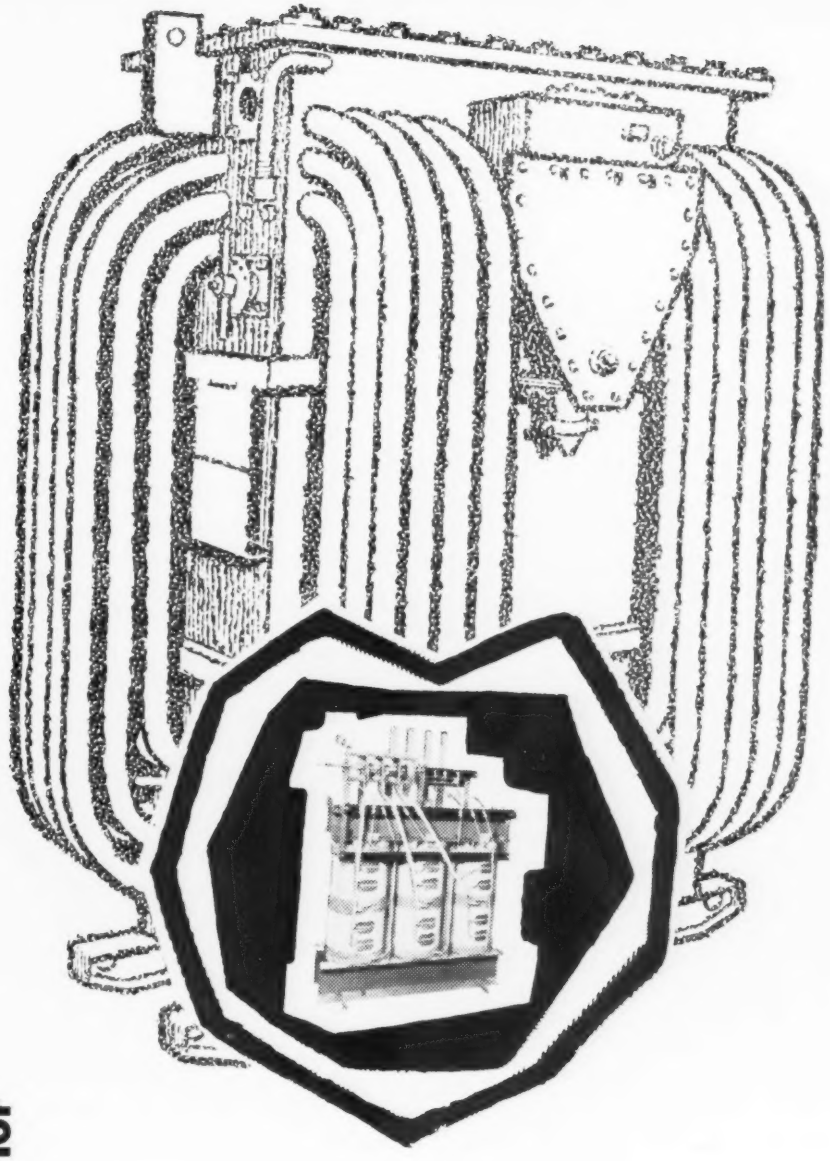

beneath this dull exterior

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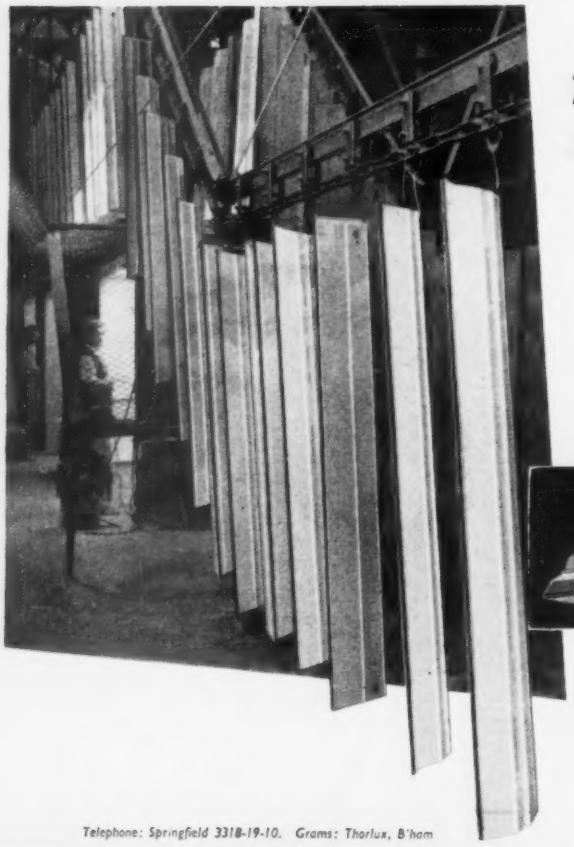

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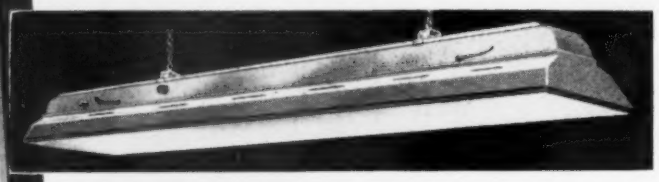

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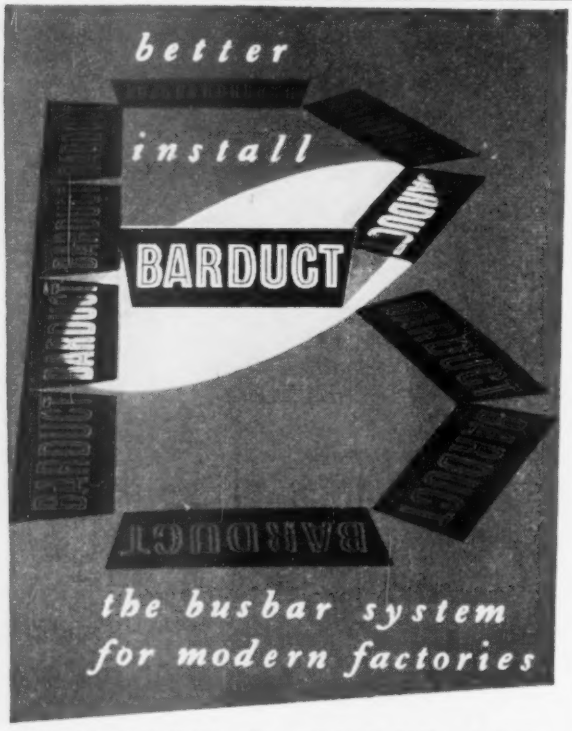

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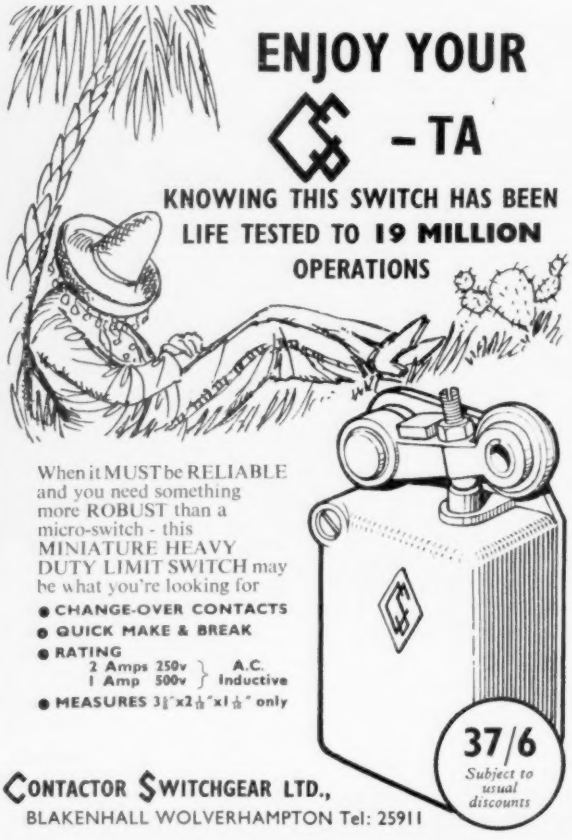
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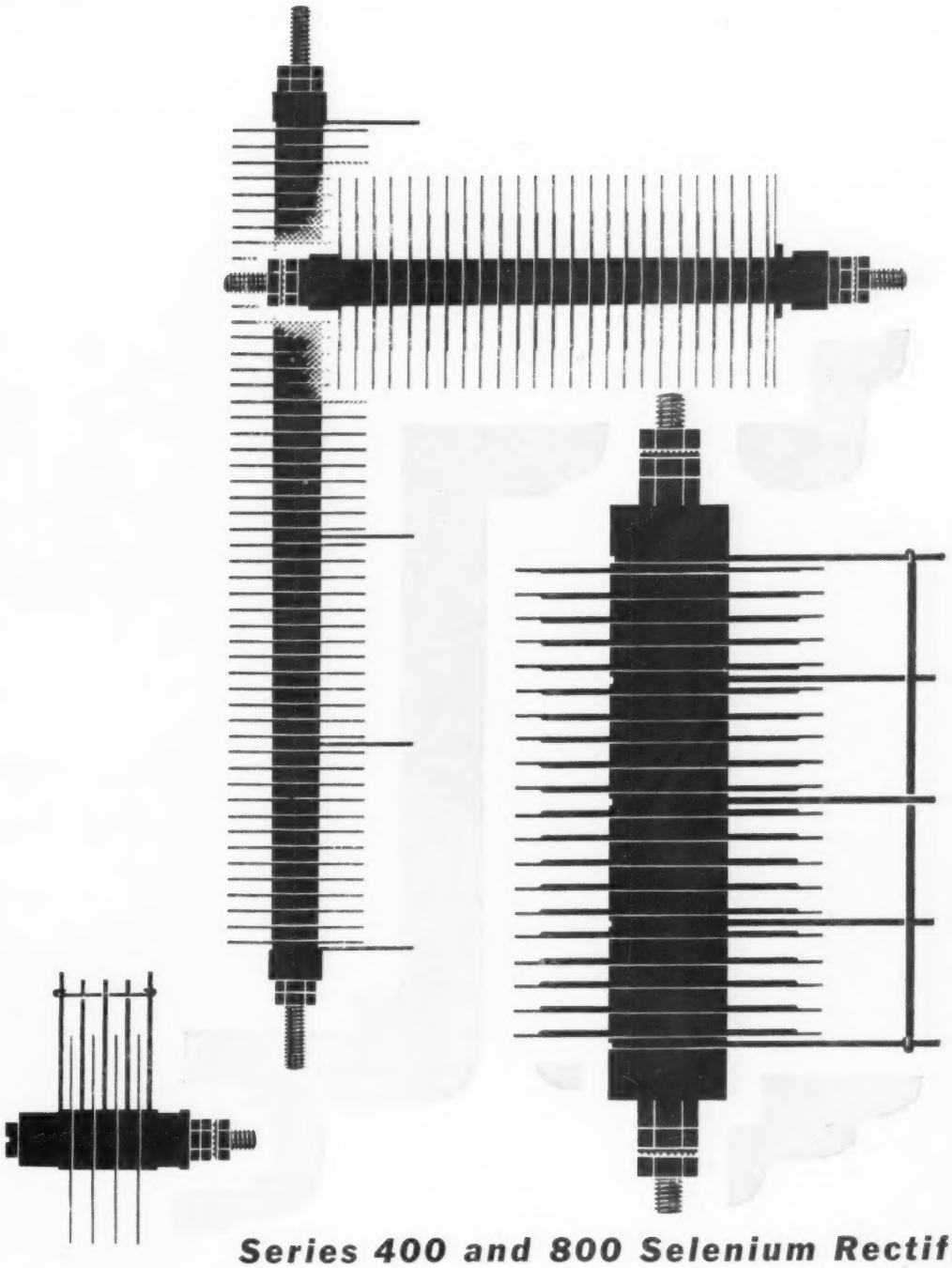

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for those who design with light

'Flo-line' combines the outstanding efficiency of Benjamin fluorescent lighting with exciting and original design of an outward simplicity, making for easy harmony with decorative schemes.

The minicell louvre is combined in one unit with translucent side panels to make an all plastic diffuser of entirely new characteristics.

Comfortable yet cheerful seeing conditions are ensured, with high illumination values.

Controllable upward light. Ceiling or pendant mounting. Access to lamps and control equipment is quick and easy. Side panels are double walled for strength.

Apparent depth of fitting only 3½ in. Total depth 4⅜ in. Half inch cube spaces in louvre give 45° cut-off.

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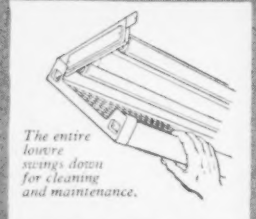

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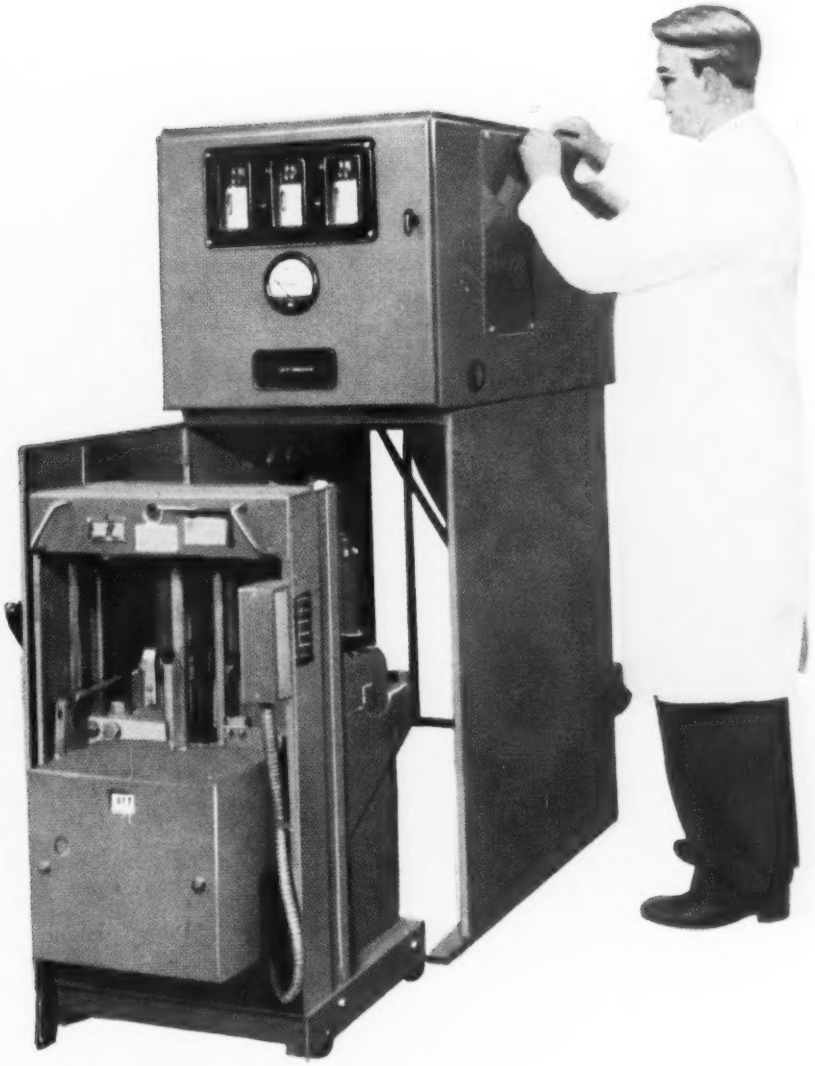

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Feeder units;
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Bus-section units;
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Features include:

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Independent-manual, spring, or solenoid closing-mechanisms.

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Complete safety interlocking.

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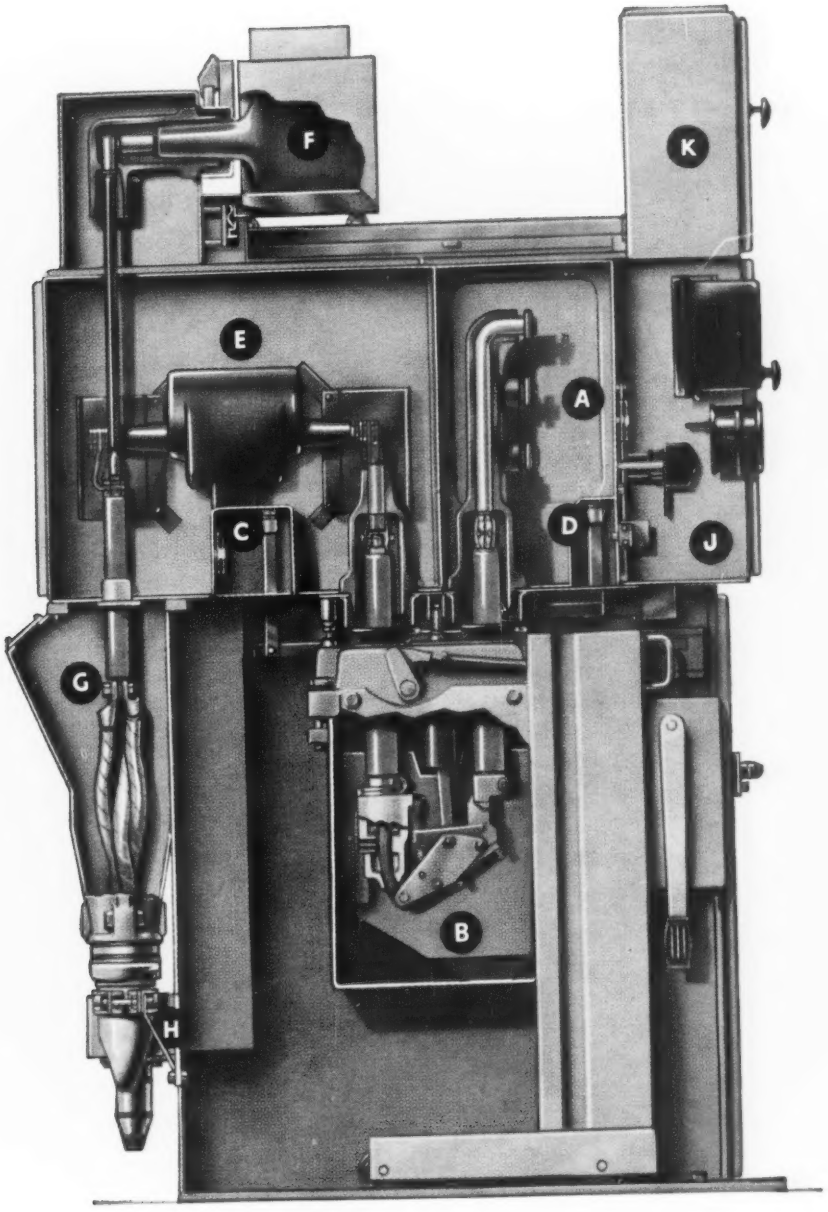

A Busbar-chamber.
B Circuit-breaker.
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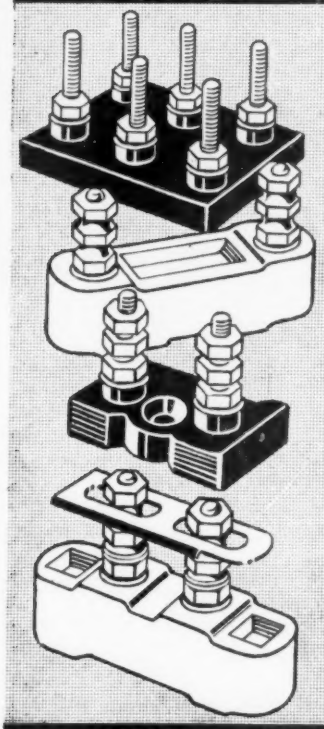

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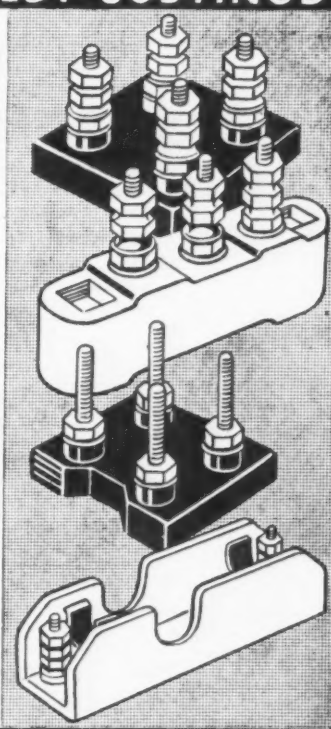

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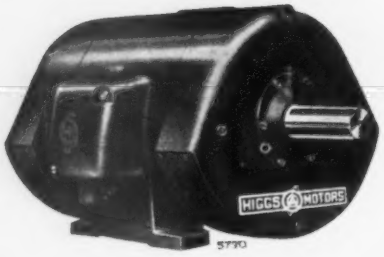

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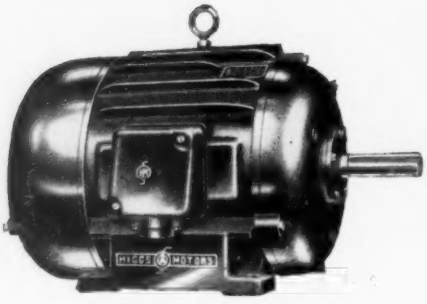

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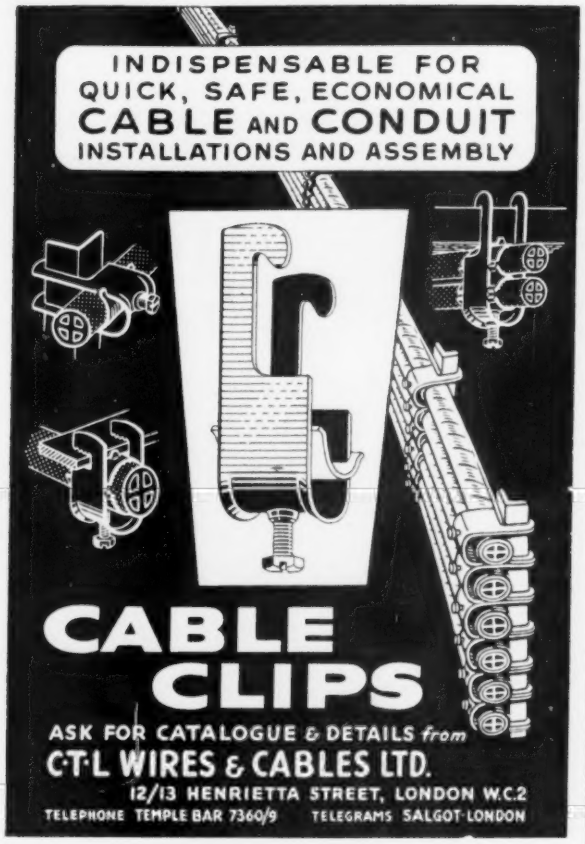

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The brand new range of Thermostats, for heating and cooling applications, specially designed by the makers of the now famous 'Pullin Plug-Stat' in co-operation with an internationally established designer.

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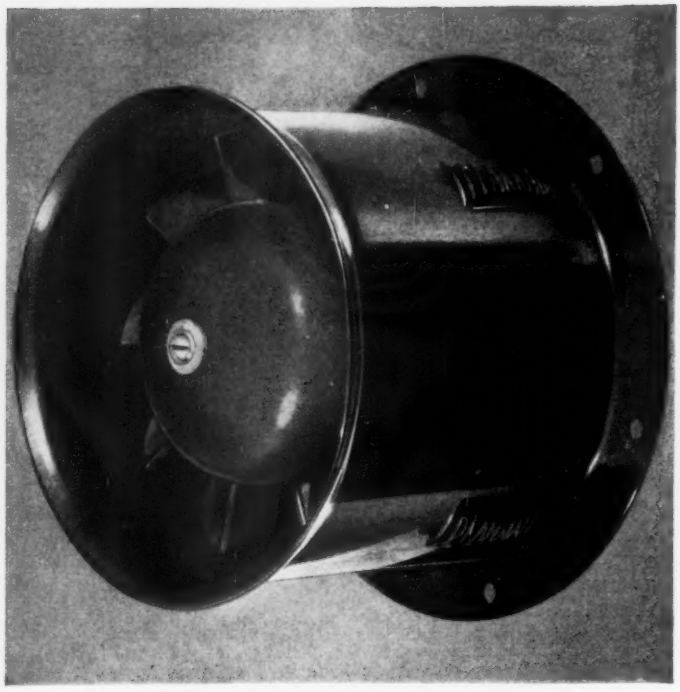
Plannair Wafters offer the Design Engineer a compact, lightweight, streamlined and particularly silent answer to problems arising from localised 'hot spots'.

Plannair, as a specialising body, is completely single-minded in its dedication to the solving of air movement and temperature control problems. Plannair contributes the most efficient blowers, weight to output, in the world today. Our knowledge could be of assistance, you think? Then we'd be more than happy to help!



The Plannair Wafter Unit 3PL101-409

TECHNICAL SPECIFICATION:

HOUSING Designed to comply with the Ministry of Aviation requirements to meet the Specification No. 1086B for tropicalisation. In light alloy anodised finish incorporating black moulded rubber resilient mouldings for supporting motor. Terminal block mounted on outside.

DIMENSION 3¼" long, 4" dia. over bell mouth, 4¾" dia. over rear flange.

WEIGHT 1 lb. 6 oz.

IMPELLER Moulded fibre glass.

MOTOR Shaded pole type wound for 110/115 V or 230 V single phase 50 cycles. Consumption 12 watts.

PERFORMANCE 50 c.f.m. under free air conditions.

SPEED 2,600 r.p.m.

NOTE: *The Plannair Wafter is available in a number of alternative housings. Send for the Plannair Wafter leaflet which gives full details of units available.*

PLANNAIR

PLANNAIR LIMITED Windfield House, Leatherhead, Surrey.
Tel: Leatherhead 4091/3 & 2231

PLA33a

NEWS SHEET

500 kV d.c. line and submarine cable recommended for NZ Cook Strait link in report by consultants, Preece, Cardew and Rider. £19m. estimated cost is £8m. lower than for a.c. alternative; feasability and reliability of h.v., d.c. endorsed in report. (595, 609)

1960 Electrical Engineers' Exhibition ends with attendance of over 75,000, 10% up on last year. Overseas interest also stronger. Signalling and communications suggested for next year's theme. Reorganisation of exhibitors' committee makes for wider representation. (596, 607)

Electric 3-climate 2-season "greenhouse of tomorrow," equipped by British manufacturers and arranged by BEAMA, is highlight of Ghent international flower show. (622)

25% increase in Uganda unit sales; total for year, 315m. units, includes bulk supply to Kenya. As Owen Falls nears completion, new 180 MW hydro station planned. (616)

Aluminium rolled busbars better than extruded for good contact says ERA report. Scratch-brushing under petroleum jelly or chemical compound follows silver plating and tinning for good jointing. (606)

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460 kV transmission line in North East Ontario proposed by H. E. Power Commission. Two sections initially to operate at 230 kV. (611)

Opening of new heating, ventilating research laboratories spotlights Association's floor-warming studies. Field tests on six installations (including three area board premises) complements analytical study to determine suitable design procedure. (596, 602)

PEOPLE—H. B. Campbell promoted to assistant chief project engineer, Southern Project Group, CEGB . . . E. Nobbs relinquishing post with Watford Electric, and R. G. Smith to be sole managing director, with M. G. Jones promoted to sales director . . . Lt-Col H. E. A. Donnelly joining Southern EB as personnel officer . . . W. J. Walpole becomes managing director, Lumenated Ceilings Ltd. . . . J. W Ringrose appointed chief applications engineer, Semiconductors Ltd. . . . Sir Ivan Stedeford named chairman of Transport Advisory Board . . . C. E. Singer becomes general manager, G. Forrest and Son . . . C. E. Perry (Evershed's) has retired. (612, 614)

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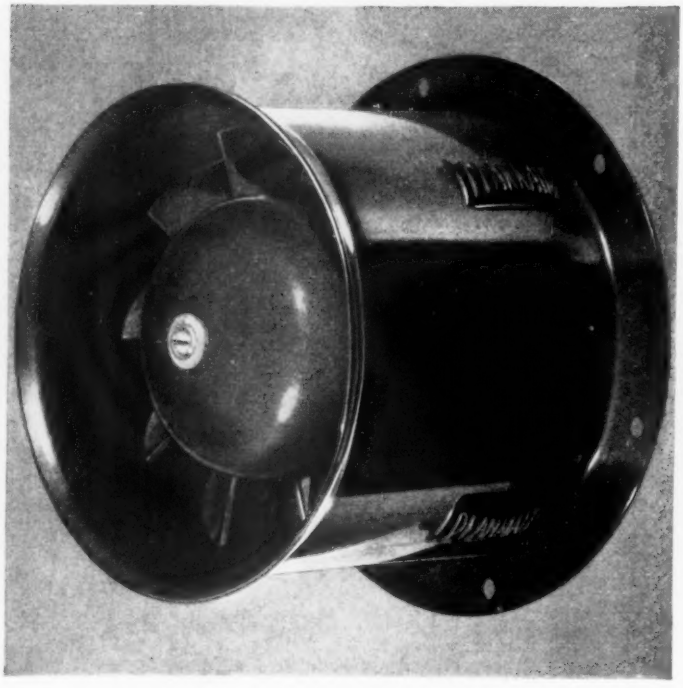

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NEWS SHEET

Modern generation schemes require high rate of response excitation. London Division electrical engineer describes effect on stability of faster excitation, looks to operation of generators as synchronous condensers, and machines designed for 0·3 short circuit ratio. (596, 597)

Versatility is major claim for thermistors, particularly as temperature measuring devices. Theory of operation, production and application discussed in IEE paper. (603)

Value of differential in domestic off-peak tariffs questioned with particular reference to floor-warming installations. (595)

Restricted tin mining reduces units sold in Malaya, output down 2·3% on year. Central Board has trebled number of consumers since 1949; sells 4½ times number of units. Two 3-MW free-piston gasifier turbo-alternators ordered. (620)

Threat deferred of three-day unofficial strike at power stations to support manual workers' wage claim, postponed until "more favourable" time. (621)

Artificial lighting to supplement daylight in offices urged by speaker at ASEE/IES meeting, in calling for change from two-point to three-point lighting. Reappraisal of luminous ceilings also needed; multi-purpose trunking demands intelligent planning. (615)

Manufacturing of Remington electric shavers to be taken over by new subsidiary company; they will also undertake marketing. (621)

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REDUCE COSTS IN INDUSTRIAL SUBSTATIONS

The illustration shows a composite 'Superform' switchboard installed in the substation of a large warehouse in the Midlands. The switchboard accommodates both the Supply Authority's open type substation equipment and the outgoing circuits to the warehouse within the one unit. The busbars of the substation board and outgoing 'Superform' section are coupled together, both electrically and mechanically, making the composite Switchboard a complete entity.

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NEWS SHEET

Modern generation schemes require high rate of response excitation. London Division electrical engineer describes effect on stability of faster excitation, looks to operation of generators as synchronous condensers, and machines designed for 0·3 short circuit ratio. (596, 597)

Versatility is major claim for thermistors, particularly as temperature measuring devices. Theory of operation, production and application discussed in IEE paper. (603)

Value of differential in domestic off-peak tariffs questioned with particular reference to floor-warming installations. (595)

Restricted tin mining reduces units sold in Malaya, output down 2·3% on year. Central Board has trebled number of consumers since 1949; sells 4½ times number of units. Two 3-MW free-piston gasifier turbo-alternators ordered. (620)

Threat deferred of three-day unofficial strike at power stations to support manual workers' wage claim, postponed until "more favourable" time. (621)

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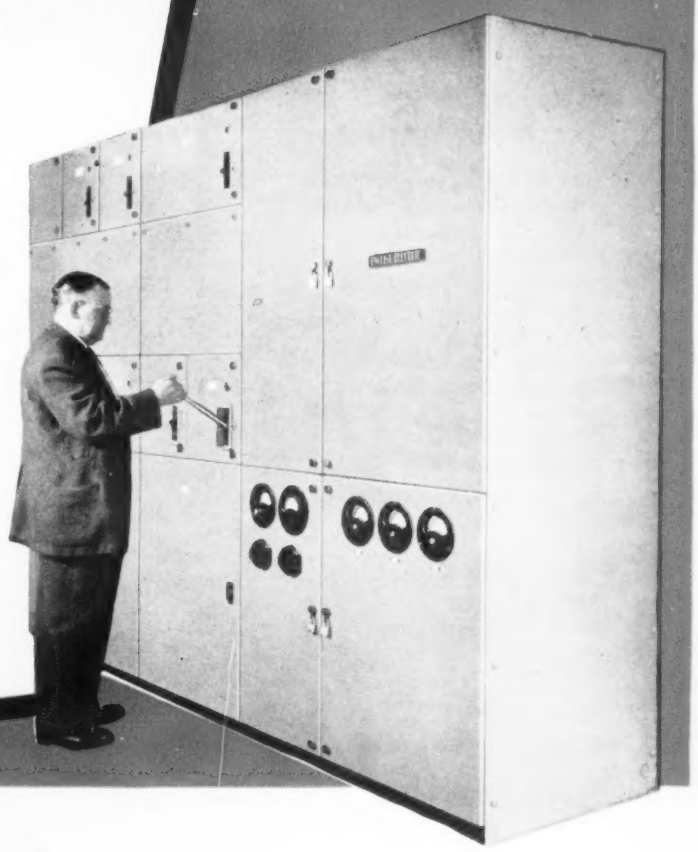

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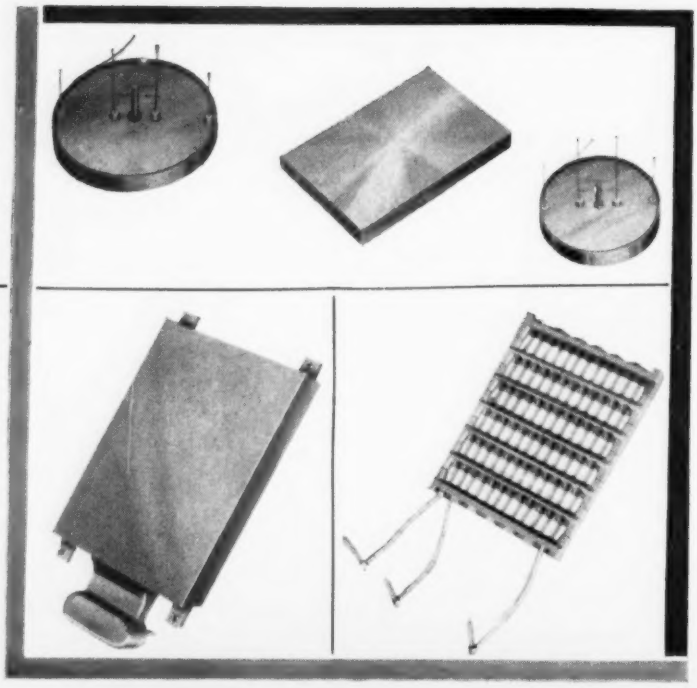

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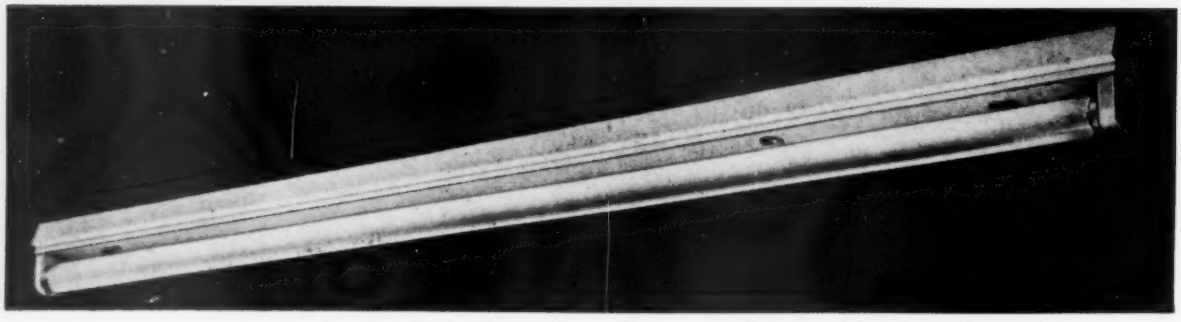

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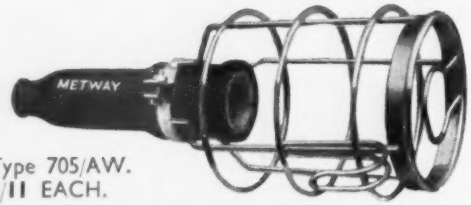

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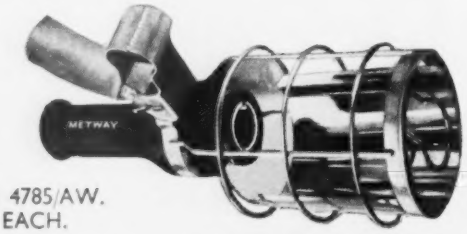

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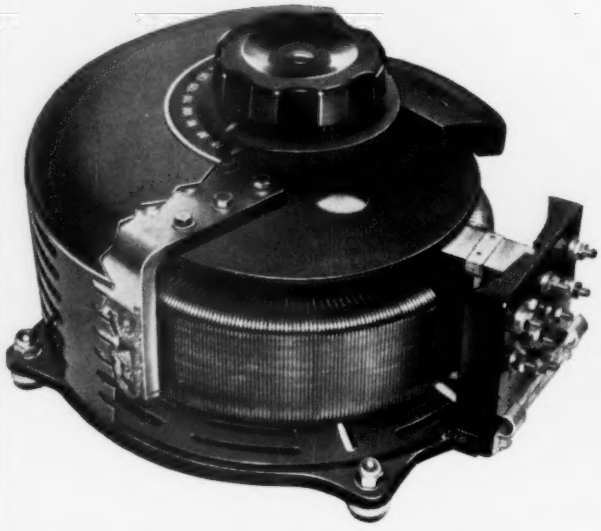

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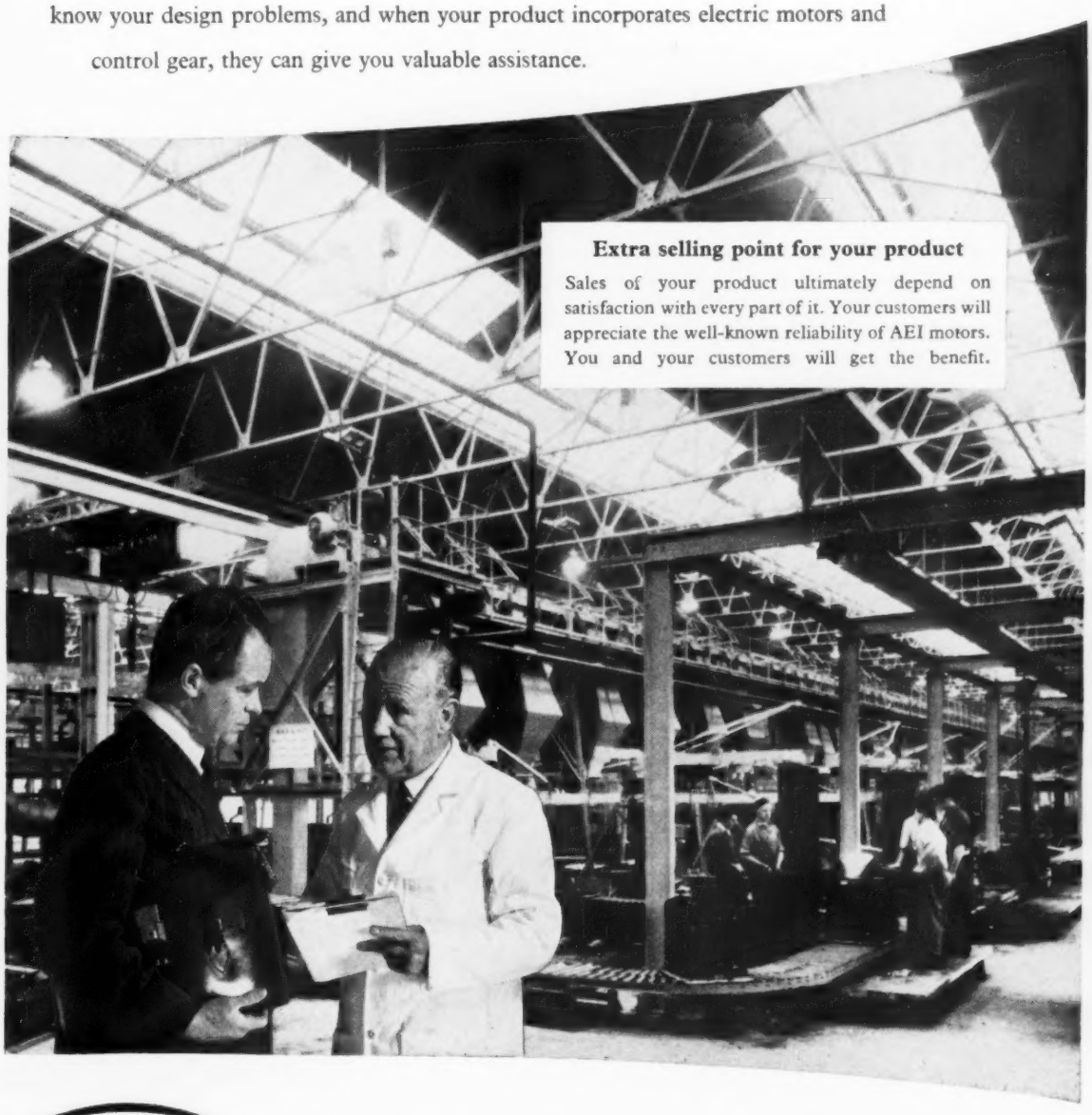

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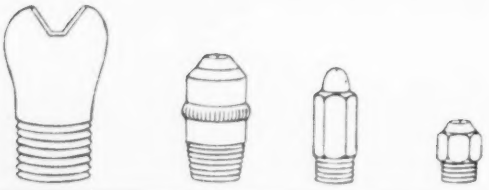

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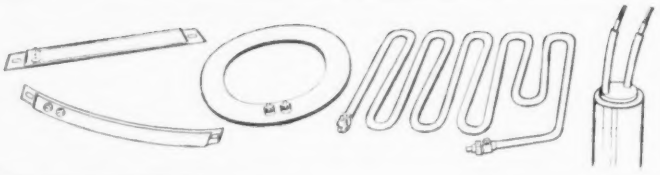

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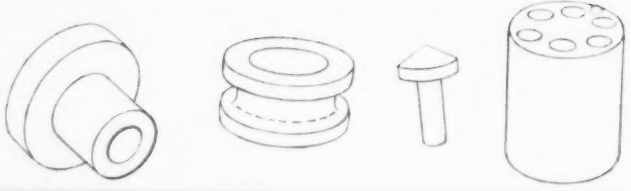

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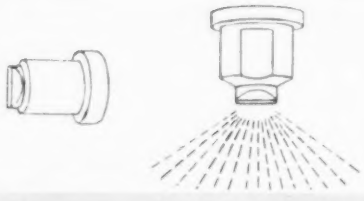

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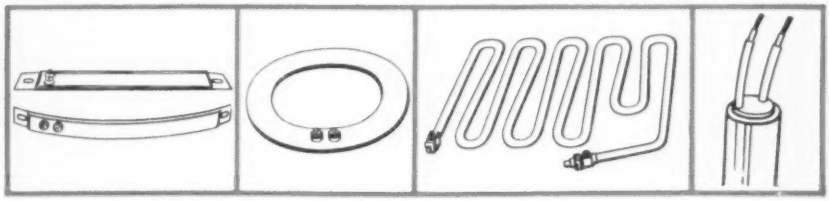

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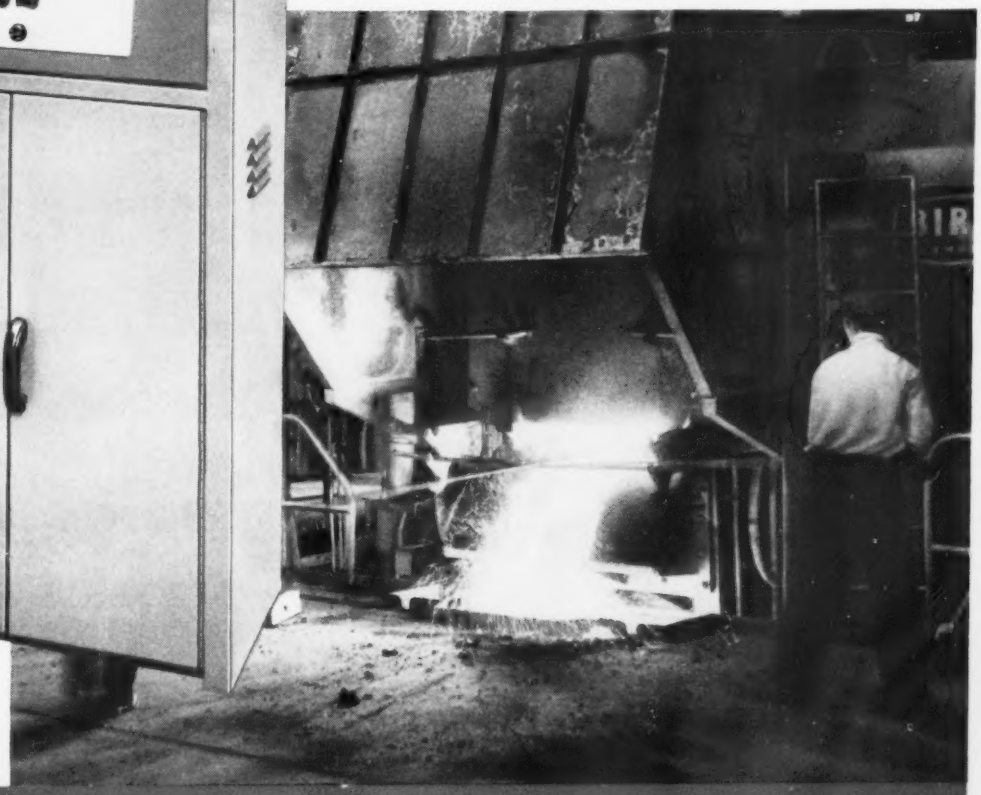

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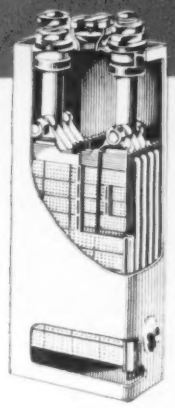

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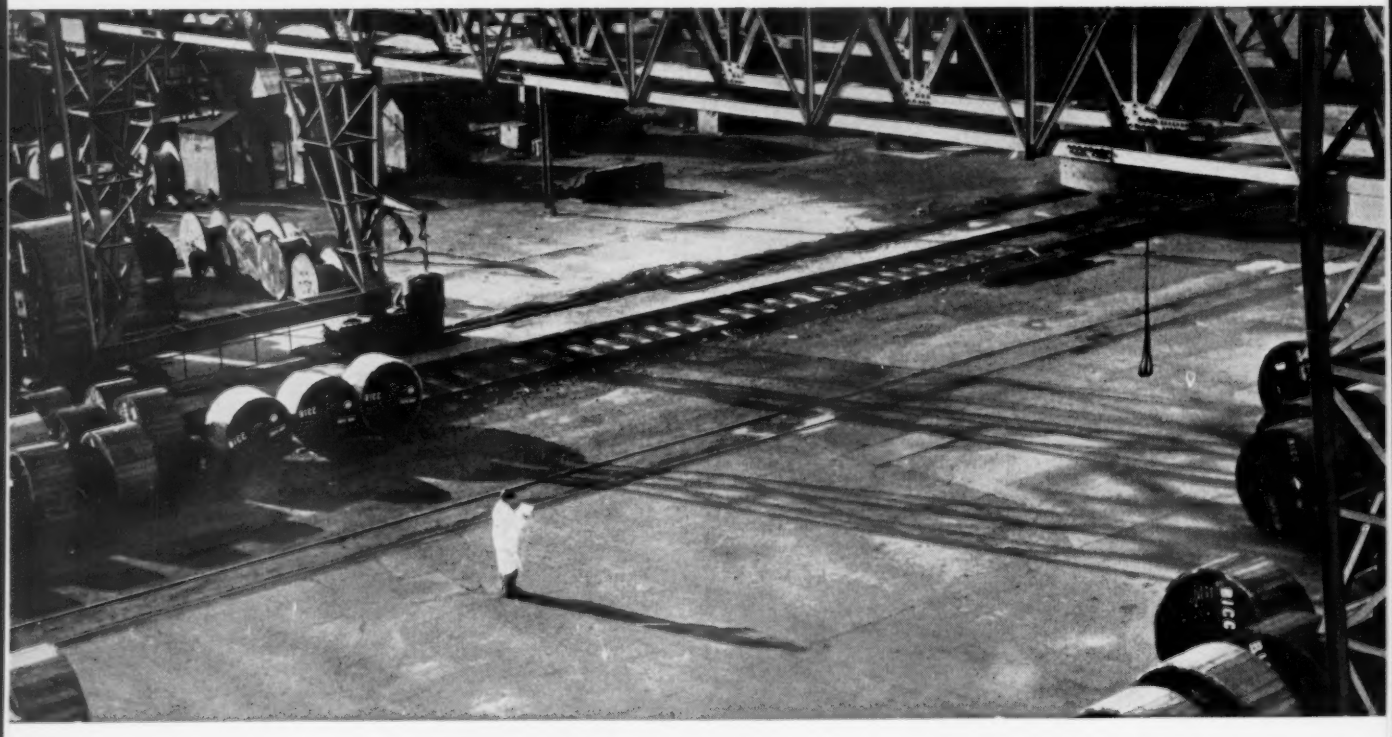

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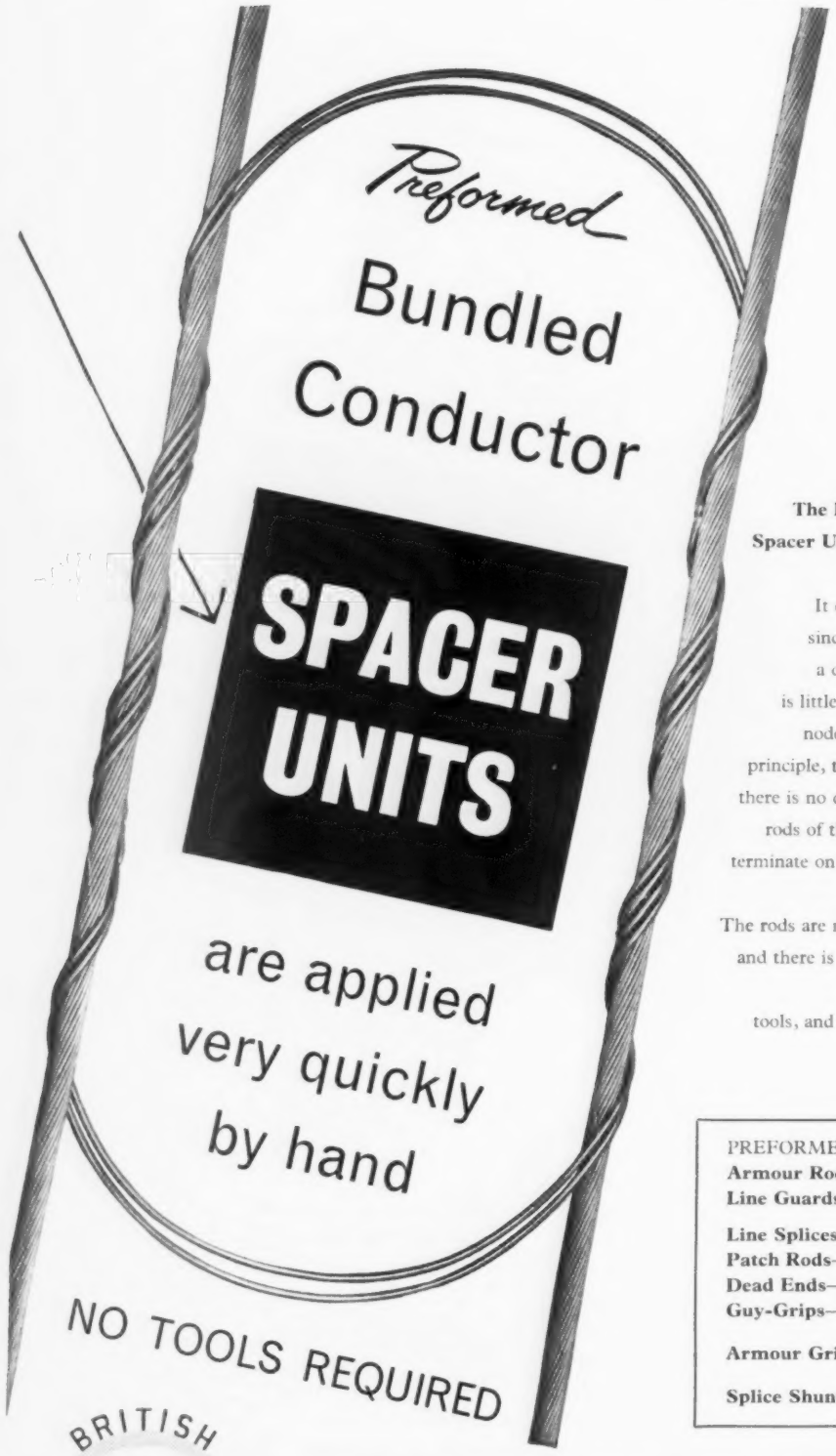

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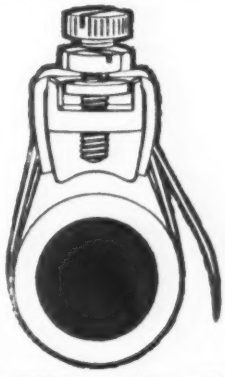

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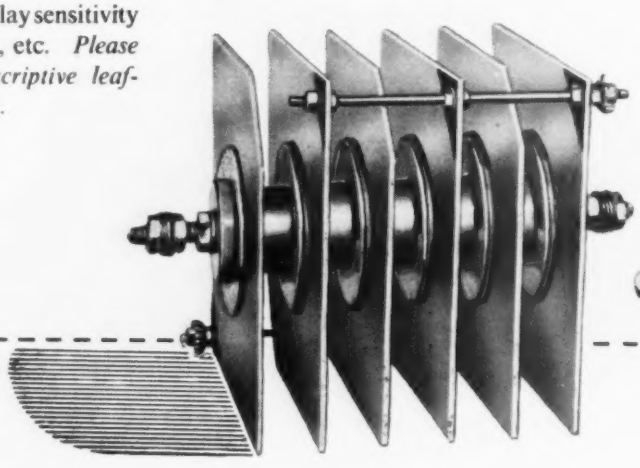

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Associated Electrical Industries Limited

INSTRUMENTATION DIVISION-Scientific Apparatus & X-Ray Department

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THURSDAY 14 APRIL, 1960
Registered as a Newspaper Volume 137 No. 15

ELECTRICAL TIMES

SARDINIA HOUSE, SARDINIA STREET, LONDON, W.C.2
Telegrams: Equivolt . Estrand Telephone: HOLborn 6016

Dans ce numéro

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Les systèmes d'excitation à action rapide pour alternateurs importants, inclus dans les systèmes d'alimentation, offrent des avantages considérables en maintenant la stabilité. Leur utilisation permet de faire fonctionner, de façon courante déja, les alternateurs avec un angle, entre l'axe du champ du rotor et le champ tournant du stator, de 70°. L'ingénieur électricien de la Division de Londres, C.E.G.B., pense que dans les conditions de certains systèmes il faudra accepter des angles de 110°. Les systèmes d'excitation à action rapide sont aussi nécessaires pour l'utilisation de turbo-générateurs comme condensateurs synchrones aux périodes de faible charge, que l'on envisage à l'heure actuelle.

Production et Utilisations des Thermistors 603

Les "Thermistors" sont des résistances sensibles à la température, possédant un coefficient résistance/température négatif important. D'une mise au point comparativement récente, et basés principalement sur l'emploi des oxydes métalliques frittés, on les utilise de manière extensive pour les commandes et les mesures thermiques ainsi que pour la mesure et la commande de quantités électriques en haute et basse fréquences. Les thermistors réagissent dans un circuit comme s'ils possédaient une réactance inductive importante, et cela permet de les employer dans des dispositifs de suppression d'onde de choc.

Idées Nouvelles dans l'Eclairage de Bureau ... 615

La pratique actuelle, qui consiste à alimenter l'éclairage à partir de deux prises par fenêtre dans les nouveaux batiments commerciaux, semble devoir entraîner de mauvaises conditions de vision. Un système à trois prises permet d'obtenir une orientation correcte des dispositifs d'éclairage par rapport à l'équipement de bureau en tenant compte de son utilisation, il permet, par ailleurs, l'utilisation pendant la journée de l'éclairage artificiel en plus de la lumière du jour.

In dieser Nummer

Vorteile schnellwirkender Erregersysteme 597

Schnellwirkende Erregersysteme für Wechselstrom-Grossgeneratoren, die an Kraftnetze angeschlossen sind, bieten wesentliche Vorteile hinsichtlich der Stabilisierung. Bei ihrer Verwendung werden Wechselstrom-Generatoren bereits häufig mit Läuferfeld-Anstellwinkeln von 70° betrieben, und nach Meinung der Chefingenieure der Londoner Abteilung der britischen Elektrizitätsbehörde werden unter gewissen Bedingungen Anstellwinkel von 100° akzeptiert werden müssen. Schnell-Erregersysteme sind auch von wesentlicher Bedeutung für die Verwendung von Turbo-Generatoren als Blindleistungsmaschine zu Zeiten geringer Belastung, wie sie derzeit in Erwägung gezogen werden.

Herstellung und Anwendung von Thermistoren ... 603

"Thermistoren" sind temperaturempfindliche Widerstände mit hoher negativer Widerstands/Temperatur-Koeffizient. Es handelt sich um eine verhältnismässig neue Entwicklung, die hauptsächlich auf gesinterten Metalloxyden beruht; Thermistoren werden weithin zur Wärmemessung und-regelung verwendet, sowie zur Messung und Regelung elektrischer Grössen niedriger und mittlerer Frequenzen. Wenn Sie eingeschaltet werden, verhalten sich Thermistoren so, als ob sie einen hohen induktiven Blindwiderstand aufweisen, was sie zur Stromstossverhütung geeignet macht.

Büroraum-Beleuchtung 615

Die gegenwärtig übliche Lichtversorgung mittels zweier Auslässe wird als Quelle ungünstiger Sichtverhältnisse betrachtet. Ein Drei-Stellen-System gestattet die richtige Orientierung der Beleuchtungskörper in Bezug auf die Büroeinrichtung und deren Benutzung; auch erleichtert es die Zuhilfenahme künstlicher Beleuchtung zur Ergänzung des Tageslichts.

Advantages of Fast Excitation Systems 597
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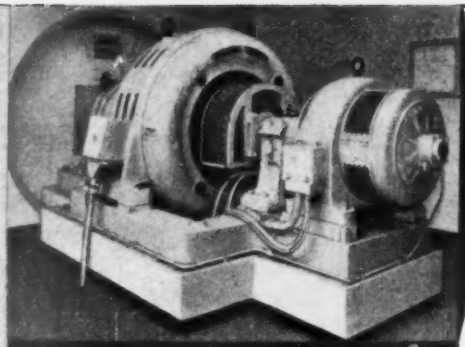

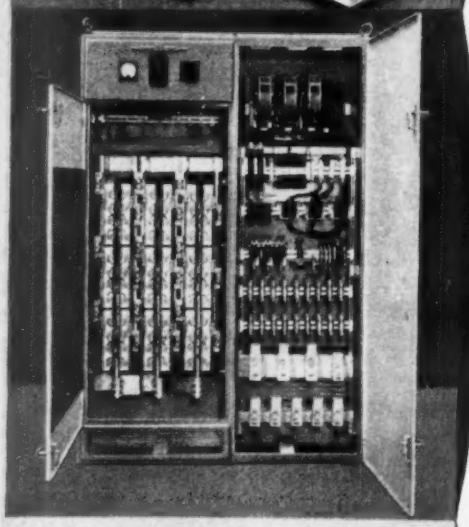

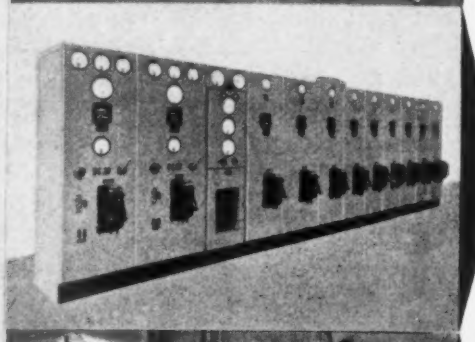

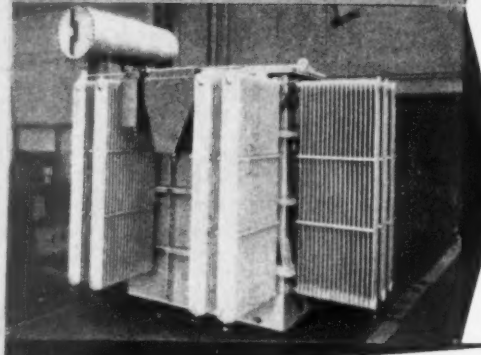

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Comment

CONFIDENCE IN H.V. D.C.

A favourable report by the consultants who have been considering the use of a high-voltage d.c. submarine cable to link New Zealand's power-hungry North Island with the surplus potential of the South Island gives a timely boost to the prospects of h.v. d.c. The Cook Strait crossing idea, involving about 25 miles of submarine cable, was put into cold storage in 1958, following a change of Government. A British consulting firm was invited to investigate the project in the light of sundry criticisms that had been advanced. The most notable feature of their report now published is the wholehearted endorsement of the practicability of a 500 kV d.c. link carrying 600 MW, vividly characterised as "larger in capacity than any similar project now being operated or constructed outside Russia." The consultants believe that such a scheme would be both practicable of construction and satisfactory in its technical performance. In part, this amounts to a vote of confidence in the ability of the potential suppliers of equipment to carry out the necessary development work in a relatively short time, for by no means all the equipment is available in proved designs. Further, although emphasis inevitably falls on the 25 mile crossing, there is a host of problems associated with the 360 miles of 500 kV d.c. overhead line that will be required if the scheme is put into operation. It is noteworthy in this respect that in the straight a.c./d.c. comparison, the extra costs of a d.c. substation is almost exactly balanced by the higher cost of overhead lines and compensation equipment in the a.c. case, eloquent comment on the savings possible with d.c. over long distances.

OFF-PEAK OR ON ?

How advantageous to the consumer is the off-peak tariff? That is a question being asked increasingly frequently by those who are considering using this method of heating for houses. The off-peak tag has become an inseparable adjunct to the electric floor-warming idea during its development. In commercial applications, and to a considerable extent in the heating of flats, the savings that follow from taking advantage of the off-peak tariffs are large enough to be a decisive factor in the choice of floor-heating. The extra costs comprising time switch equipment, extra metering, separate circuits and, perhaps, a higher loading of floor-warming cable than would be required in an unrestricted installation are readily enough swamped. When houses are considered, the charge for rental of a time switch and separate metering combines with other costs to become a factor of significance when compared with the savings obtained by qualifying for the off-peak unit rate

rather than the last block of the basic domestic tariff. If domestic off-peak tariffs imposing the least restrictions are considered, the savings per unit vary from a maximum of 0·4d to under 0·1d; that is not enough to be a decisive attraction to the householder who has been sold on the many merits of floor-warming from the comfort and convenience aspects. It has to be remembered that anything floor-warming can do off-peak, it will do better unrestricted. The restricted hour schedules do not fit in so well with the domestic timetable as they do with offices and shops, and the additional flexibility that unrestricted operation of a floor-warming system brings can be used to particular advantage in a house, probably with a marked reduction in energy consumption. If the floor-warming is applied in its most suitable role of background heating, then the arguments about cost are reinforced. The supply industry must come to terms with this situation, which even in its technical aspects alone is one of considerable complexity, if it is to continue to reap maximum advantage from the growing liking that the general public and its architectural advisers are evincing for electrical floor-warming.

FAST EXCITATION FOR LARGE SETS

Fast-acting excitation systems for large alternators have been developed over recent years to match the twin problems of large, highly rated machines and extensive transmission systems. The growth in set rating has brought in its trail lower inherent electrical stability, while system operation considerations require that alternators should be operated at rotor angles well past their steady-state stability limit. This week the first of a short series of articles on fast excitation systems develops in more detail these problems, and shows how the improvements offered by exciter and a.v.r. designers have largely solved them and, indeed, made it possible to push more economically into the future. The magnitude of the problem is illustrated by our author, the electrical engineer of the London division, CEGB, with reference to the situation that will before long apply in the metropolis. At August Bank Holiday, early in the morning, the London cable network will be demanding 800 MVAr of leading current, and there will be only 500 MW of local power demand to match this. To deal with this situation, sets will have to be operated at high leading power factors, or more ambitiously, motored from the system and excited as synchronous condensers. It is only possible to contemplate such operation because of the high rate of response that modern excitation systems can provide, allowing operation at rotor angles well into the dynamic region. In turn, the availability of suitable excitation schemes is making it practicable to contemplate alternators designed at considerably lower short-circuit ratios than have been acceptable before, values as low as 0·3 being predicted, again with worth-while gains in economy so far as first cost of the machines is concerned.

KEEPING THE EXHIBITION GENERAL

The results of the 1960 Electrical Engineers' Exhibition should encourage the organisers in their belief that they are still on the right lines. Attendances were substantially up on last year, not only in respect of aggregate figures, but also in the overseas representation that remains so important to the country's economy. Moreover, last year's impression that the disadvantage was lessening of firms being sited on the first floor of the exhibition was confirmed. That there are displays of importance upstairs has become well recognised by regular visitors to this annual exhibition, and the increased number of stands there has had its predictable cumulative effect in increasing the number of visitors willing to make the ascent. There remains room on the first floor for a small but significant increase in the number of stands to be accommodated. This is a point of some moment when suggestions are heard that the exhibition should change from its general character and become more specialised, on the grounds that some apparatus and accessories manufacturers are finding it difficult to make the display they would like. For contractors in particular, the opportunity to see and talk about a wide coverage of the industry's products is too valuable to be whittled down by more specialisation.

RESEARCH FOR HEATING

The phenomenon of the growth of floor-warming, which in the space of a few years has become one of the basic methods of heating buildings, received a signal endorsement last week. At the opening of the new laboratories of the Heating and Ventilating Research Association it was disclosed that one of their principal studies is that of electric floor-warming. As the major support for this association comes from contractors operating in the heating and ventilating field, this is recognition indeed! At present the work is mainly confined to field studies of six installations of varying types, supplemented by a theoretical examination of basic thermal principles, exploring such apparent anomalies as the uniformity of air temperature, maintained despite a varying heat input. Whatever may be the conclusions of this work, they will bear the stamp of an organisation with no specific electrical interests, one that is looking at a wide range of heating problems. Its work is likely to have other, less direct impacts on the electrical industry, particularly in such matters as air movement and physical conditions. One field in which the Association sets an example is in the operational work studies it is carrying out on such simple operations as pipe jointing, with a view to reducing labour costs. No doubt it is the strong contractor representation on the association that has influenced work in this direction; surely there are many activities in the electrical industry that could bear similar investigation by an electrical body.

Meteor

This week's quick summary of electrical news faces advertisement page 12

Advantages of fast excitation systems

by E. B. Powell,* M.I.C.E., M.I.Mech.E., M.I.E.E.

A TALK on the advantages of modern excitation systems for turbo-generators must of necessity entail some discussion of the stable operation of generators in parallel with large interconnected systems. It is as well to start by defining such concepts as short-circuit ratio, saturated synchronous reactance, and the torque angle equation application to turbo-generators.

Basic Concepts

Fig. 1 shows the open circuit and short circuit characteristics of a machine with a short-circuit ratio of 0·85. The short-circuit characteristic of a generator is obtained by applying a three-phase short to the terminals and gradually increasing the voltage until full load current is flowing in the stator. The "short-circuit ratio" is the ratio between the current to produce nominal volts on open circuit and that required to circulate full load current in the stator. In Fig. 1 the s.c.r. for the full line is AB/AD =0·85 for the dotted, while short-circuit line AB/AB= 1·0.

Under short-circuit conditions only about 10% of the rotor current is used to generate the requisite voltage, the remainder being required to counteract the armature reaction of the stator current. The armature reaction is dependent on the electrical loading of the stator (usually expressed in ampere-conductors/cm) and a machine with heavy electrical loading will tend to have a low s.c.r. It was common parlance some years ago to refer to generators with a low short-circuit ratio as "copper machines" while those with a high s.c.r. were known as "iron machines". In order to keep down the size of alternator frames, every effort is made to keep the short-circuit ratio as low as possible. The present day figure is about 0·5, while future designs for large machines may be reduced to as low as 0·3. The saturated synchronous reactance is usually assumed to be 1/(s.c.r.).

The behaviour of machines can be determined from the simple equation:

$$\text{Power} = (E_1 E_2 \sin \theta)/X$$

where E_1 = terminal volts

E_2 = internal volts due to the field

$X = 1/(\text{s.c.r.})$ = saturated synchronous reactance

θ = the rotor angle with reference to the terminal volts.

It is clear from this equation that the rotor angle will be greater with machines having a low short-circuit ratio.

Fig. 2 shows the power-angle curves of two machines of s.c.r. 1·0 and 0·5 respectively. It is clear from the sine curve that with fixed excitation the machine is stable under steady-state conditions only when increasing rotor angle is accompanied by increasing power output. In practice one has to allow for overswinging due to inertia. Thus with constant excitation the maximum operating angle is between 45° and 50°. This angle can be increased to 65° by using voltage regulators of the normal type.

If the machines were running at 0·6 p.u. load and, due to a system disturbance, they were subjected to a power swing up to 0·75 p.u., then it will be seen that the machine with s.c.r. = 1·0 is quite stable with a starting angle of 25° and a swing to 30°, whereas the machine with 0·5 s.c.r. starts at 55° and swings to about its stability limit (Fig. 2).

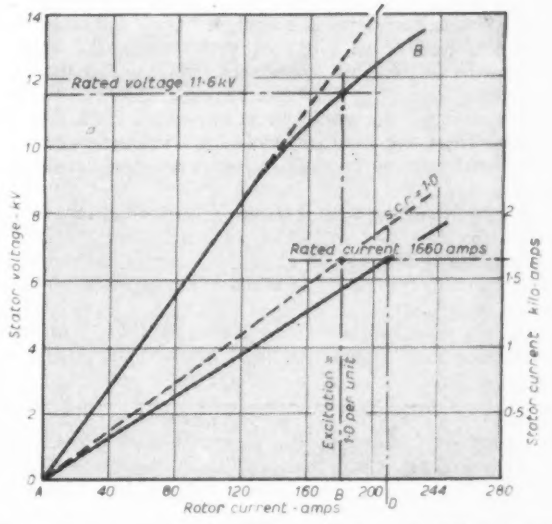


Fig. 1. Open-circuit and short-circuit curves for a 33 MVA generator with 0·85 short-circuit ratio

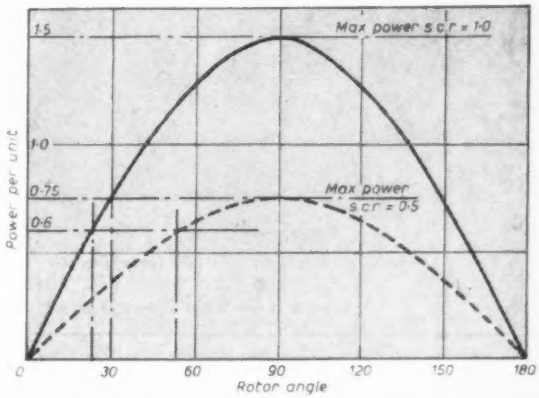


Fig. 2. Power-angle curves for two machines of s.c.r. 1·0 and 0·5 respectively for excitation of 1·5 p.u.

* Mr Powell is electrical engineer, London division, CEGB. This article is effectively the full text of the inaugural lecture in a course on fast excitation systems for modern turbo-alternators, held at the Borough Polytechnic. (Organising lecturer: Mr L. F. Spence, B.SC., B.SC.(ECON.), D.R.T.C., A.M.I.E.E.)

Turning to some questions of exciter design, a feature of modern machines is that the direct current for exciting the alternator rotor is usually obtained from separately-excited d.c. generators. These can be separate motor-generator sets but are generally connected to the shaft of the main machine, either directly or through gearing.

Early Exciters

Exciters on the older plant were of the shunt-wound self-excited type. These had some serious disadvantages which led to their use being discontinued except for smaller machines. A typical characteristic of a shunt-wound exciter is as shown in Fig. 3. Since the curve up to where saturation begins is a straight line, it indicates that over this part of its range of performance, the exciter will not be stable. This will be seen from the fact that the controlling or setting resistance required, that is, BE/OE, is the same for the whole range of voltage from O-B. It is clear from this that a stable output voltage cannot be obtained from any one control resistance position in this range.

An improvement was obtained by arranging for earlier saturation of a part of the magnetic circuit, but this improvement is only gained at the expense of an increased field current. This results in a restriction of output from a given frame size.

System disturbances such as faults, switching transients, or sudden loss of generator load, cause rapid changes in stator current. The generator flux linkage cannot change appreciably during extremely small intervals of time, with the result that rapid changes in the stator ampere-turns must be matched, in accordance with the constant flux linkage theory, by a similar change in the rotor ampere-turns. This is brought about by the circulation of induced currents in the damper windings, iron, and main windings of the rotor.

Sudden rotor current changes alter the shunt exciter output voltage and may result in a reversal of polarity. The rapid increase of current in the rotor windings under short-circuit conditions is shown in Fig. 4. These disturbances, therefore, are not always self-restoring with a shunt exciter.

Another important factor is that the shunt exciter takes up to five times as long to recover as an exciter with a separately energised field winding.

A pilot exciter is therefore employed to give a constant voltage separate excitation for the field of the main exciter. This machine is a level-compounded d.c. generator with a nearly-saturated iron circuit. Alternators equipped with this type of exciter can supply the load current variation required without materially affecting the exciter's output voltage.

Up to a certain stage in the development of the supply system, this excitation equipment, together with the automatic voltage regulators in use, was quite satisfactory. Generators generally had high short-circuit ratios, of the order of 1·0, and were therefore possessed of good stability characteristics. Moreover, the supply system characteristics in this country were not such as to make generator stability a serious problem.

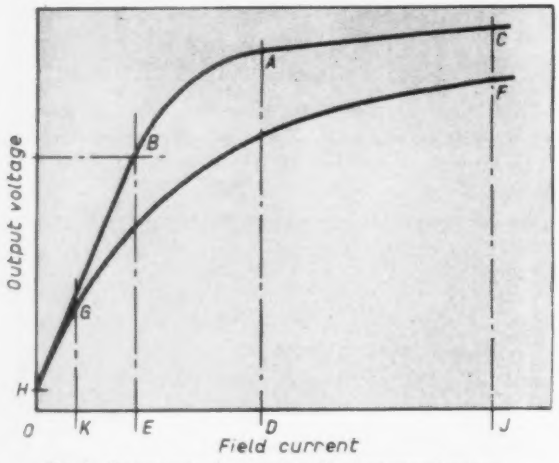


Fig. 3. Open-circuit characteristic for shunt-wound exciter

Early A.V.R's

The automatic voltage regulator has developed from the early types, such as the Tirrill or Brown Boveri regulators. The Tirrill is a vibrating contact type in which the required voltage is maintained by a continual regulation of a portion of the exciter field resistance by vibrating contacts. The Brown Boveri is in effect an automatically controlled field resistance. A more modern regulator is the so-called quiescent type which regulates on a certain definite percentage error and has the advantage of a motor-controlled exciter rheostat following the variation called for by the regulator.

Speed of response in voltage regulators was not at this time a major factor. In fact, from a response point of view the development of the quiescent type was a retrograde step. The old Tirrill type of regulator, by virtue of its constantly operating contacts, was actually a quite fast acting regulator. The test shown in Fig. 5 illustrates how a Tirrill regulator was able to control a 19 MW machine subjected to a system disturbance when it was running at a rotor angle of 85°. The dotted line shows the machine going out of synchronism after the switch shorting the reactor was opened with the machine running at 85°. The full line shows exactly the same conditions but with the Tirrill regulator in control.

The later quiescent regulators have the disadvantage of a "dead band," necessarily introduced by their operation between certain set voltage difference or "error" conditions.

With the expansion of the electricity supply system, fast excitation control systems became desirable and will, in

Table I. MVAr Requirements of 275 kV Lines.

		Two 100-mile double circuit lines in parallel.		One 100-mile double circuit line. Before voltage regulator takes effect.		One 100-mile double circuit line. After voltage regulator has balanced the voltage	
1.	Sending end voltage E_S	275 kV		275 kV		275 kV	
2.	Receiving end voltage E_T	275 kV		261 kV		275 kV	
3.	Line Angle	10·5		22·09		21·1	
		Per Line	*Total*	*Per Line*	*Total*	*Per Line*	*Total*
4.	Power at Sending end P_S	260	1,040	520	1,040	520	1,040
5.	Power at Receiving end P_T	255	1,020	497	994	500	1,000
6.	MVAr's Imported at Sending end Q_S	—3·0	—12·0	+115	+230	+42	+84
7.	MVAr's Exported at Receiving end Q_T	—51	—204	—85	—170	—150	—300
8.	MVAr Loss in Line (line 7 — line 6)	48	192	200	400	192	384

the case of machines with a low s.c.r., be a necessity.

The application of modern technique to excitation and control has resulted in the development of systems with very fast response. Also, the control power required to initiate changes has become very small—of the order of 1/5000th of that required in a normal main exciter. A response speed of maximum voltage change from positive to negative in less than 0·5 sec can be achieved. The reduction in short-circuit ratio has, of course, meant that generators will not have the same inherent stability as in the past. Also, the growth of the power network interconnections with greatly increased mileages of lines and cables introduces problems of the supply and distribution of MVAr and of voltage control.

Need for Fast-response Systems

The most economic use of power lines dictates that as far as possible the required MVAr should be generated or absorbed locally rather than be transmitted over system interconnectors. It is quite a simple matter to design a system so that the MVAr demand can be generated locally under normal operating conditions. It is just a question of providing an adequate margin on the generating plant for MVAr output and/or installing synchronous condensers or static plant such as shunt capacitors or reactors at suitable points. The rapid variation of megavars which have to be generated in the event of a long high voltage transmission line tripping when transmitting large blocks of load is, however, quite another problem. It can only be satisfactorily solved by the use of high rate of response voltage regulators.

A very simple example illustrates the problem. Consider two double-circuit 275 kV lines, each circuit transmitting 260 MW over 100 miles, the sending end and receiving end conditions being as shown in the Table 1.

The MVAr losses are, of course, doubled, and in order to cover this contingency some 200 MVAr of reserve plant equally distributed between the sending and receiving ends will have to be kept available in order to provide the MVAr losses on this section of the 275 kV system. This will consist of either synchronous condenser or reserve generating plant which can provide the necessary megavars by excitation adjustment. In the event of a double circuit line being switched in again by auto-reclosing, the excitation system on the plant would have to readjust itself in order to take into account the reduction of the MVAr losses to their original value. This procedure will tend to cause heavy voltage fluctuations in the system unless high-rate-of-response voltage regulation is available. In this simple example the charging MVAr of each line, which is some 45 MVAr, has been neglected, since it has an almost negligible effect on the MVAr losses.

At times of light load, the charging MVAr of the system may be sufficiently high to cause an excessive voltage rise at the receiving end and it will be necessary to absorb MVAr's in order to keep the voltage under control. This can be done to a limited extent by operating any synchronous plant that is suitably sited on the system with very weak fields. In the vicinity of large metropolitan areas, where the main transmission is by h.t. cables, the charging MVAr may exceed the minimum night load conditions very considerably. In London, for example, the charging MVAr at 2 a.m. on August Bank Holidays will soon be 800 MVAr, while the local load will be only 500 MW.

The local MVAr absorption for such cases will probably be met either by operating the generating plant at light load and at leading power factors, or by motoring the sets from the system and using the generators as synchronous condensers. When generators are operating at leading power factors, i.e., with a weak field, the rotor angle is greater than usual and the risk of instability is increased.

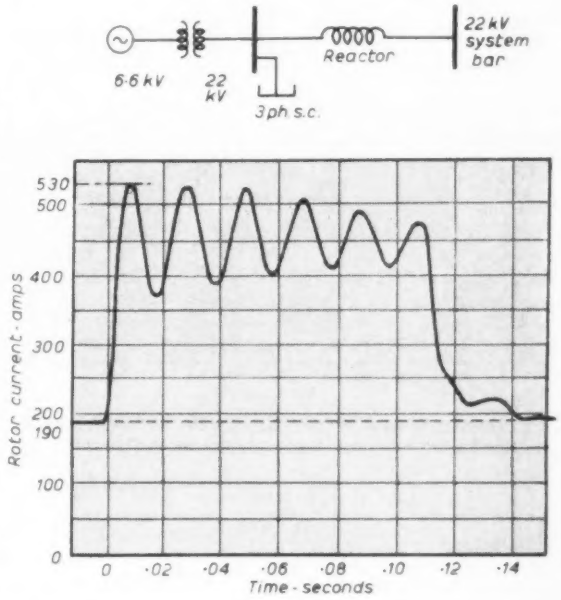


Fig. 4. Curve showing rotor current for a 19 MW generator during a three-phase short circuit. Fault duration, 0·11 sec

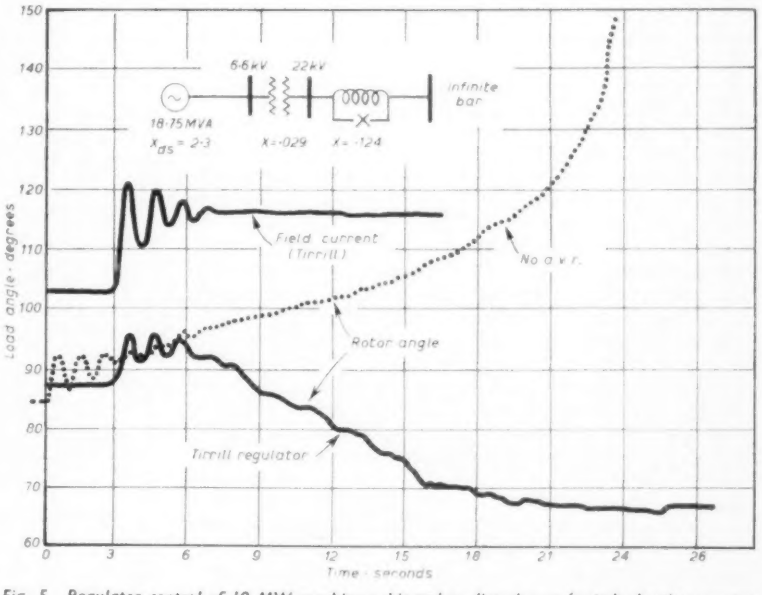


Fig. 5. Regulator control of 19 MW machine subjected to disturbance (switch shorting reactor opened) when running at rotor angle of 85° (full line). The dotted line shows the behaviour without the regulator

This can be seen by reference to the torque-angle equation whence it is clear that any increase of the internal volts of the machine will raise the maximum power output for a given load angle. This is illustrated on Fig. 6, which shows the power-angle curves for the same machine under two different excitation conditions.

High Rotor Angles

The diagrams in Fig. 7, which is another way of interpreting the torque angle equation, are drawn for two machines with a rated power factor of 0·8, and for short circuit ratios of 1·0 and 0·5 respectively. The maximum

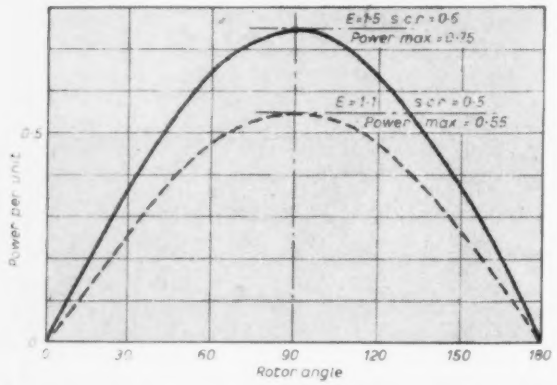


Fig. 6. Power-angle curves for machine under two excitation conditions, showing how rotor angle is greater when the field is weaker

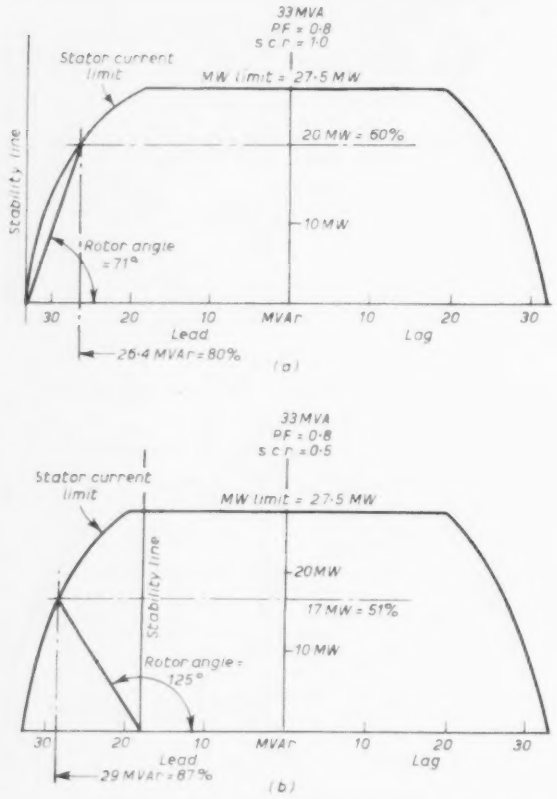


Fig. 7. MW/MVAr curves for two machines, both rated 33 MVA, 0·8 p.f., (a) with s.c.r. = 1·0, (b) with s.c.r. = 0·5

MVAr absorption occurs at 90°. With a normal excitation system this condition is, of course, unstable. It is also seen that the rated MVAr output can only be obtained with a short-circuit ratio of 1·0, the power output being then zero. The machine, when carrying its rated MVA, can, however, absorb 80% in leading MVAr's and 60% MW, with a rotor angle of 71°. This angle is on the high side for stable operation when normal excitation and voltage regulators are used.

In the case of the machine with an s.c.r. of 0·5, if the machine can be made to operate stably at angles greater than 90°, the MVAr output can be increased. This is known as operating in the "dynamic region," which can be perfectly safe with high-rate of-response voltage regulators. For example, if the machine is operated at 125°, the MVAr will be slightly greater than that in the previous case. This means that by the use of high-rate-of-response regulators the MVAr absorption is not restricted, even though the short-circuit ratio is reduced.

The reason why generators can operate stably in the "dynamic region" can best be explained by considering the simplified problem dealt with in Fig. 8.

The generator is connected to a large system, which can be considered as an infinite bus, via two reactors in parallel. The machine is loaded to 0·60 unit load, with an angle between the internal voltage of the machine and the infinite bus voltage of 116°. The plant will continue to operate under these conditions until some disturbing influence occurs.

Assume that one of the reactors is switched out. This will increase the value of the reactance and according to the torque angle equation the unit power output of the generator is reduced to 0·578 and the machine is now operating on a sine wave E=1·48 instead of 1·54 which was the initial condition. The power input for the turbine, however, remains constant so the generator rotor will start to accelerate. Due to the voltage at the infinite bus remaining constant, the voltage at the machine terminals will be reduced as the power transmitted, which is at a heavily leading power factor, increases. This reduction in

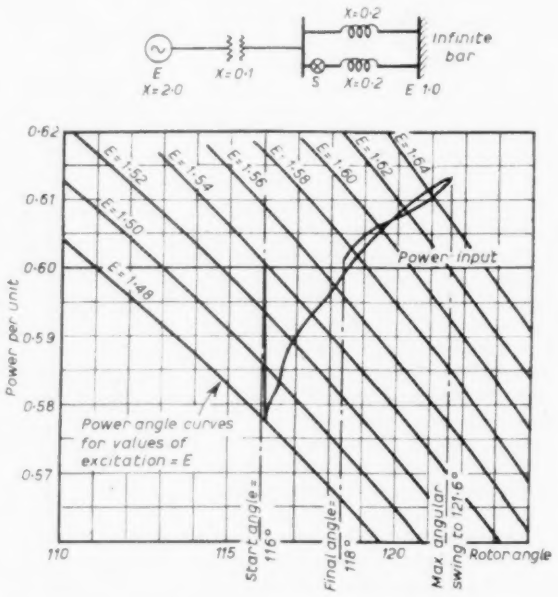


Fig. 8. Diagrammatic representation of the action of a high-speed a.v.r. on a machine running at a load angle of 116° and subject to a disturbance when the circled switch controlling the lower reactor is tripped

voltage at the machine terminals will bring the voltage regulator into operation and increase the excitation. As the machine accelerates, the high-rate-of-response exciter is increasing the internal volts of the machine and thus increasing the output of the set. When the rotor reaches 118·5° the output is again equal to the power input. Due to inertia, however, the rotor will continue to advance in angle relative to the infinite busbar volts until the increase in stored energy put into the rotor between 116° and 118·5° equals the kinetic energy given up by the set when operating above the power input line, which occurs when the high-rate-of-response exciter has increased the sine wave to E=1·65, the angle then being 121·6°. The set's output is now higher than the input and the rotor slows down until the input and output are again equal, which is at 118·4° on a sine wave of E=1·57. Due to inertia the rotor will continue to oscillate backwards and forwards from this angle, finally stabilising at about 118°, due to the action of the voltage regulator, in about two or three seconds, the total time of swinging being, say, five seconds.

This example, which has been worked out by step-by-step methods, gives some idea of how high rate of response exciters with a high speed regulator will hold plant stable in the "dynamic region." In practice the oscillations will be less than shown, due to the heavy damping effects which were ignored in the calculations. Tests have proved that such high angle running conditions are possible, and Fig. 9 shows a 60 MW generator running at over 120° quite stably under the control of a modern high speed automatic voltage regulator.

Conclusions

About 30 years ago, fault-clearing times of 0·5 to 1·0 second were quite normal. Clearing times these days are considered rather in terms of cycles than seconds, rarely exceeding 6 cycles or 0·12 sec. The operation of excitation control during a fault is not so important as its effect after the fault has cleared. Rapid excitation control following a disturbance, however, operates to reduce the decrement of flux linkages or even to reverse the trend and increase them. It is, therefore, clear that the faster the excitation response is, the more effective it is in maintaining stability.

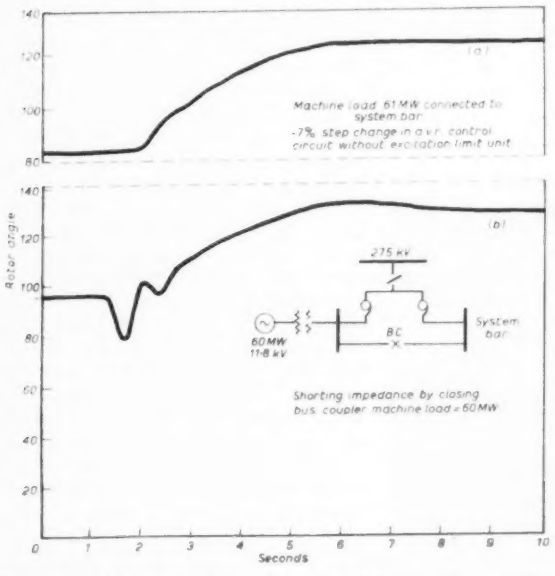


Fig. 9. Results of tests to show stabilty of a 60 MW machine operating at high rotor angle under control of a modern high-speed a.v.r.

Such excitation systems also operate to reduce disturbances to voltage caused by faults, power line switching, swinging of machines, or the disconnection of a generator.

The gradual tendency over the last 20 years to increase the rotor angles of generators, with reference to the main system voltage, when operating in parallel with large interconnected systems, is of interest. Prior to the war engineers were loth to operate plant fully loaded at unity power factor, due to the risk of instability. The rotor angles then were as a rule in the region of 52° for machines having a short-circuit ratio of 0·70. With the advent of the modern voltage regulators plant is now frequently operated at 70° and, in the author's opinion, rotor angles of 110° will have to be adopted under certain conditions.

The use of turbo-generators as synchronous condensers for absorbing MVAr at times of light load is also under consideration, and in this field the use of high rate of response excitation systems is essential.

It is against this background that the recent course of lectures on fast excitation systems for modern turbo-generators may be of interest to power supply engineers.

In conclusion, the author would like to express his sincere thanks to his colleague, Mr H. A. Allsop, A.M.I.E.E., for his valuable help and suggestions in preparing this article, and to the Central Electricity Generating Board for permission to publish the talk.

Automation in Supply

ELECTRICITY supply has always applied to a high degree automation in its generally understood sense. The advent of the digital computer has brought the opportunity for a major step forward in this field, so that it is possible to look forward to a single mechanised programme for system planning and to a co-ordinated automatic control for system operation. This is the opinion of two US experts in this field, Messrs C. Concordia and F. J. Maginniss (Electric Utility Engineering Section, General Electric Co. Schenectady, NY) as expressed in a paper to this year's American Power Conference.

An important feature of the paper is its extensive bibliography of references applications of computers to power system problems, taken from American sources. This covers most sections of supply work. Amongst the ideas the authors themselves put forward is one relating to system protective relaying. They suggest that the intelligence supplied to the relay might come from what is in effect a special automatic diagnostic computer, which would take all available information from whatever source, and arrive at the most-probably-best decision about what switches should be operated. The basic idea is that it is not always possible to decide whether or not to interrupt a particular circuit solely on the basis of its own behaviour. This idea is not immediately practicable of application; but the authors comment that the possibility that it may become feasible in the future cannot be overlooked.

In their conclusions, the authors express confidence that there is no doubt that automation of steam generating stations will become the rule, and that it will be integrated with system load despatching and generation programming. On the other hand, they feel that integration with transmission and distribution system operation in the sense of a single overall computer controller is not yet indicated.

Co-operative heating research

FLOOR-WARMING STUDIES AT NEW H.V.R.A. LABORATORIES

READERS may recall our reference some months ago (31 December, 1959) to the floor-warming installation at the MEB's new Gloucestershire sub-area headquarters being used by the Heating and Ventilating Research Association as part of a research programme into floor-warming. The opening, by Lord Hailsham, last week, of the laboratory of the HVRA at Bracknell, Berks, provided an opportunity to see, at close hand, something of the work of this new research organisation.

A co-operative research organisation for the heating and ventilating industry, this body was formed (as a council) at the end of 1955, being incorporated in its present form only as recently as last July. Initially, it rented accommodation at the BCURA laboratories at Leatherhead, taking up residence in its new premises last November. Operating on an income which last year amounted to £23,000, it is, as yet, a small organisation with a technical complement of ten, under its director, N. S. Billington, M.SC., M.I.H.V.E., M.A.S.H.R.A.E.

The work of the Association is directed into five main channels: heating, ventilation and air conditioning, operations research, physical and chemical problems and information services. Their study of off-peak electric floor-warming is a recent addition, and insufficient information has been obtained so far to enable the association to draw any firm conclusions, but they hope to present a report by the end of the year. The main problem being tackled is the accuracy of the design procedure, and this is being considered by a committee set up at the request of the IHVE, for which the association acts as secretariat. Its chairman is A. B. Mann, C.B.E. (Chief Engineer, Ministry of Works), and it includes three representatives of the electrical industry; its terms of reference are to examine the thermal principles of design of off-peak electric floor-warming and to consider their suitability in terms of site, type of building construction and usage.

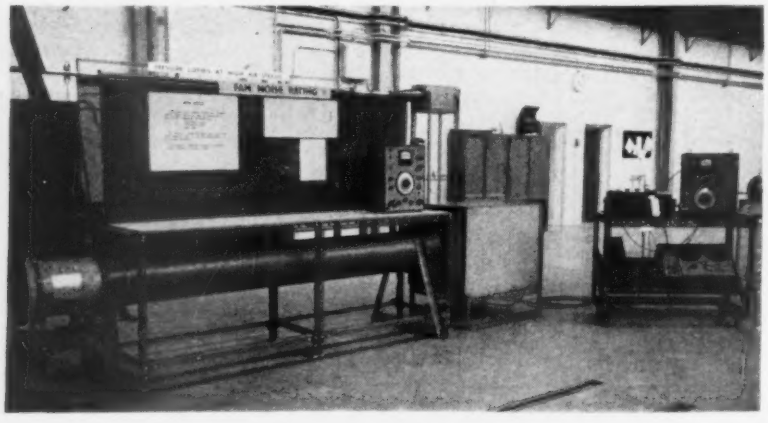
Concurrently with the work of the committee, field tests are being conducted in six buildings in the southern half of the country. Apart from the MEB installation, there are two other electricity board premises, a small factory, a school and a government office building. Design is also being tackled from a theoretical standpoint by numerical analysis of the thermal behaviour of a typical building, carried out in the association's laboratory.

Analysis is effected using Harrison's finite-difference method, which indicates that floor and air temperatures will vary cyclically as the installation is energised during the night and at midday. One of the problems is to reconcile this cyclic variation with the comparatively steady temperatures (particularly of the air) recorded in the field tests; the influence of incidental thermal gains from lighting, occupants and the sun is being investigated. The Association is concerned only with non-domestic installations, but works closely with the Building Research Association, where the main concern is domestic and where an analytical study by analogue methods is being carried out.

Ventilation Rates

Another study which has an important bearing on floor-warming and other heating methods is that of ventilation rates. Most ventilation-rate figures are averages produced from observations over a period of time and these, of course, do not provide any indication of peak air-change rates at any instant. The Association is studying the accurate, instantaneous measurement of ventilation rate using a large test chamber which can be ventilated at variable, known rates. Hydrogen is injected into the chamber in quantities controlled with respect to the ventilation rate to maintain constant proportion of 0·1% in the atmosphere of the chamber. It has been shown from this work that the rate of hydrogen injection is proportional to the ventilation rate, and it hoped to draw up charts which can be applied, with appropriate correcting factors, to particular cases in practice to give a direct measurement of ventilation rate.

A great deal of commercial heating, apart from floor-warming, is intermittent in character, usually being switched on and off at given times each day. As has been found with floor-warming, however, to delay the starting up in periods of warmer temperature will produce fuel savings. Study by the Association of pre-heat control has shown that a time-temperature regulator can be used in conjunction with fuel-fired, hot-water heating systems to reduce the quantity of fuel used by a few per cent each year, using the return water temperature as a measure of the actual building temperature.



Fan noise is one of the subjects under investigation at the Association's new laboratories. Seen here is equipment used to investigate certain aspects of in-duct testing

Production and application of thermistors

SURVEY OF PROGRESS IN APPLICATION AND UTILISATION

A THERMISTOR is a temperature-sensitive resistor which differs from the usual metal resistors in that its resistance/temperature coefficient is negative; that is to say, the resistivity decreases with an increase of temperature and vice versa. The principle was first recorded by Faraday in 1837 in relation to silver sulphide and the characteristic has been known and extensively used in carbon conductors and elements for the best part of a century. The specialised application of the property and the production of the sintered oxide semiconductor materials as we understand thermistors today is, however, little more than 25 years old.

Modern thermistors are based on mixed ferrites, tri-ferric tetroxide with traces of lithium or oxides of vanadium, chromium, titanium, tungsten, etc. The objective behind research for newer thermistor materials is a larger resistance/temperature coefficient—present values of production elements range from 1-5% per degree C—better stability and manufacturing techniques resulting in an improved consistency of production. An excellent survey of the present-day position of semiconductor thermistors in the electrical industry was given in a paper* before the Measurement and Control Section of the IEE in London on 5 April in which the authors described the theory of their operation, current manufacturing techniques and some of the fields of application.

Theory of Operation

In their survey of the present-day theory of operation, they first divide solid materials into three broad groups, conductors, semiconductors and insulators, according to their resistivities on the arbitrary basis of conductors having resistivities of less than 0·1 ohm/cm, semiconductors falling between 0·1 and 10^9 ohm/cm and insulators with resistivities greater than 10^9 ohm/cm. The more scientific division is, however, on the basis of the energy gap which is non-existent in conductors, lies between 0·1 and 3 eV for semiconductors and exceeds 3 eV for an insulator. There is, of course, no rigid division between the groups and the values are purely arbitrary ones. Making reference to the qualitative summary based on the work of Goudet and Meuleau as to the theory of operation, they point out that no quantitative theory appears to exist which can satisfactorily explain the behaviour of oxide semiconductors.

This is borne out in the succeeding section where equations relating the various factors of importance to the semiconductor engineer are developed on a theoretical basis. No less than ten constants appear, some of which are arbitrary, others empirical and the remainder themselves dependent upon one or more of the other constants. It is natural that the designer should find the greatest use of those in which the constants are, or are based on, the empirical values.

Design Factors

Resistance Temperature Characteristic

The relation between resistance and temperature follows an exponential law according to the equation

$$R = R\infty \exp \frac{B}{T}$$

where R = the resistance in ohms, $R\infty$ is the value of R when the thermistor temperature tends to infinity, B is a constant and T is the absolute temperature. Actual values for particular materials have to be determined experimentally.

Dissipation Constant

The incremental dissipation constant—the power required for unit temperature rise—depends on environment, type of element (bead, rod, flake, etc.) and mounting. Strictly, it is not a constant but depends to a degree on the temperature at which it is measured. It is expressed in microwatts per degree C and is represented by the symbol K.

Time Constant

The time taken for the excess temperature of the thermistor to drop on cooling is known as the time-constant and is proportional to the product of density, volume and specific heat divided by K, the dissipation constant. It is represented by the Greek symbol τ and values K and τ for various types of construction are given. Other factors dealt with in the paper are the temperature coefficient, half temperature and the voltage maximum.

Manufacture of Thermistors

The four basic forms of thermistor are rod, disc, flake and bead, according to the final shape of the semiconductor body. The basic materials are intimately mixed and ground to a homogeneous fine powder, which is bound by an organic binder, shaped to the required form, sintered at a temperature of 1,000-1,300°C, and dried. The unit is then aged to achieve electrical stability. Resistivity is controlled mainly by adjustment of the proportions of the ingredients minor variations being corrected by slight variations in the firing temperatures.

Rod types are usually made by combining the powdered oxides with an organic binder to form a plastic compound which is extruded through a die, generally of circular cross section, cut to length, dried and fired slowly. Disc and washer-shaped bodies are made in machines similar to those for pelletting medicinal products while flake-type thermistors are made by applying the material in suspension on to a glass plate to form a film, cutting the dried film into flakes and firing. The latter, used as sensitive infra-red detectors, are understood not yet to be in production outside America.

* Paper 3176: "Thermistors, Their Theory, Manufacture and Application," by R. W. A. Scarr, B.SC.(ENG.), PH.D., A.M.I.E.E.; and R. A. Setterington, B.SC., of Standard Telephones and Cables Ltd.

Beads are made by manually applying drops of a slurry containing the semiconductor material at intervals along two fine platinum wires held parallel in tension, drying, sintering and cutting to produce the individual beads.

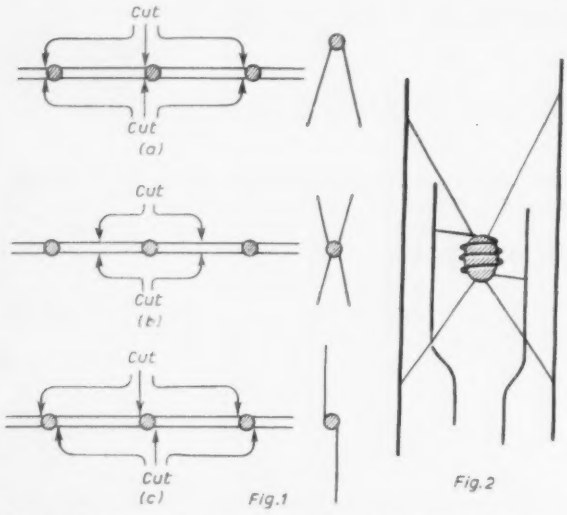


Fig. 1. Diagrammatic representation of bead thermistor production showing different cuts for assembly with (Fig. 2) the basis of construction of an indirectly heated bead thermistor

There are three methods of parting the beads according to the manner in which the terminating wires are to be disposed in the final assembly. The beads may be directly heated by the passage of current through the wires or indirectly heated by an encircling heater coil leaving the wires as leads for the measurement of resistance.

Attachment of terminal wires to the thermistor elements other than beads is by metal spraying or sintering on a metallic paste to which the wire can be attached by a soft solder which, however, must be of a melting point adequate to withstand the ambient temperature conditions of the body.

Application of Thermistors

Today the field of application for thermistors is both wide and expanding. For temperature measurement it offers the advantages of small size, large temperature coefficient, ability to withstand electrical and mechanical stresses, a wide operating range from sub-zero to 200°C temperatures, and a wide range of resistance values. Against this has to be set a non-linear resistance temperature characteristic, the need for auxiliary apparatus in giving a temperature reading and a reputed inability to maintain calibration.

By connecting resistors in series parallel with a thermistor, the characteristic can be adjusted to give linear presentation. For recording temperature, a Wheatstone bridge circuit with a thermistor in one arm is advisable and published literature contains many variants of circuit for this purpose using thermistors. Long-term stability is also suspect but, from tests on a batch of 50 thermistors over a period of one year, a stability of ± 0·2°C seems a reasonable expectation.

Compared with other methods of temperature measurement, all with their own particular fields in which they excel, the thermistor's major claim is, perhaps, its versatility of application, which ranges from the measurement of soil, air and water temperature down to the determination of subcutaneous blood temperature from a tiny element inside the needle of a hypodermic syringe. Having a relatively large resistance/temperature characteristic, it may be shaped and balanced to that of an opposing element in a compensation network and there are many known applications of this in practice today. Thermistors can also be used in the measurement of thermal conductivity since, if it is heated by an electric current, its resistance will depend not only on the heating effect of the current but also on the rate of dissipation of the heat to the surrounding medium which, in turn, is dependent on the thermal conductivity of the medium. They can also be used for the measurement of infra-red radiation, but in recent months indium antimonide and lead telluride compounds have tended to replace them in this field of application.

In audio and radio fields the indirectly heated thermistor can act as an a.c. to d.c. transfer device, subject to limitations which are imposed by the degree of matching obtainable between thermistors in a circuit in which the change in resistance of one bead element heated from an a.c. source is compared with that of its companion element heated from a d.c. source.

Thermistors behave in a circuit as if they have a large inductive reactance and this property enables one to delay the operation of a current-operated device, to suppress a switching surge in circuits employing lamps, valve heaters, etc., in starting small electric motors and suppressing telephone bell tinkle.

In applying thermistors to practical usage, a great deal has been learned about their behaviour and properties but there is still much more to discover. For example, the knowledge of its noise behaviour is far from complete. Despite this, the thermistor ranks as one of the most versatile two-terminal devices known in electrical engineering and one which has already proved itself to be robust, reliable, compact and sensitive.

DISCUSSION

Dr F. C. Widdis, opening the discussion, said that, though the temperature stability figures appeared to be quite promising, additional work was desirable. In the past he had found over-much reliance on mercury-in-glass thermometers for temperature measurements and, in confined spaces, the use of thermistors for this purpose had advantages though he had found difficulty in obtaining the accuracy claimed in the paper except in carefully controlled conditions. As a transfer device, he had been able to show that the indirectly heated thermistor was almost error free up to 50 kc/s.

Dr A. J. Maddock requested further information on long term stability from manufacturers; M. J. A. Brownley described a thermistor type oscillator which had been constructed at Northampton College and mentioned the uses of digital and analogue computers in the solving of non-linear circuit problems in connection with thermistor circuits.

Mr A. C. Lynch accused the authors of over simplification in their assessment of an equivalent circuit. Deprecating the value of analogue and digital computers in the study of thermistor behaviour, he thought that the best analogue of a thermistor was another thermistor.

Dr A. K. Johschar queried the argument in the paper that conduction in thermistors was purely electronic and Mr J. Evans followed by stating that in a number of cases the barriers seemed to be inactive and the properties were those of the individual grains. Mr M. A. Snelling remarked that, since thermistors appeared to be electronic in conduction there should be no difference between ageing characteristics under a.c. or d.c. conditions. Messrs W. H. P. Leslie, H. R. Westway, and Dr H. J. Goldschmidt also raised points on the question of stability and Messrs R. J. Wagner and J. K. Webb contributed to the discussion. Mr R. A. Setterington briefly replied.

Readers Views

Correspondents writing under pseudonyms are asked to submit their names and addresses in confidence to the Editor

Cooker Loading

REFERRING to Mr Maynard's letter published in 28 January, 1960, issue of the ELECTRICAL TIMES, I find this correspondence regarding cooker loading mildly amusing, as whoever heard of a domestic cooker in practical use with all boiling plates, grill and oven on "high" simultaneously? In the rare cases where all are in use, some at least will be in the "low" position.

It may be of interest for your readers to note that in the case of the Standards Association of Australia Wiring Rules, this is taken care of in the case of domestic cookers by the following rule for rating the relevant sub-circuit:

> Full connected load up to 10 amps, plus half the load in excess of 10 amps, each conductor being considered independently.

This means that a 12 kW single-phase, 240 volt cooker could just be used on a 30 amp circuit, or more conservatively, would make use of the new 45 amp control units. Here the Sydney County Council allows a cooker of 10 kW maximum on 240 volt single phase, larger models being on 415 volt three-phase. Other authorities, unfortunately, have lower limits for maximum single-phase load and usually require medium size cookers to be connected two-phase.

Having regard to diversity, I would not regard Mr Maynard's 60 amp service as inadequate, unless his heating load is large.

E. Ingman, A.M.I.E.E.,
LINDFIELD,
N.S.W. AUSTRALIA.

Protection for C.M.R. motors

MR HUNT (24 March) will find that one of the advantages of the dashpot overload relay over the thermal relay is that when the occasional very high inertia load is to be started and the overload relay trips prematurely, it is only necessary for higher viscosity fluid to be used to extend the tripping time, without—and this is the extremely important point—rendering the overload relay ineffective by setting the tripping point higher than 1·1 to 1·15 by f.l.c. In any event, one of the things I have tried so hard to establish is that electricians must be told that relays for c.m.r. motors must not be set higher than 1·15 by f.l.c.

As to Mr Hunt's suggestion for the use of a thermostat in the motor winding, I think he is on the right track, but one thermostat is not sufficient for protection against both overload and single phasing. To be effective, thermostats would have to be inserted in each phase of the winding and, what is more, the bimetal element should be in intimate contact with the winding so that heat transfer, already delayed by the insulation, is rapid.

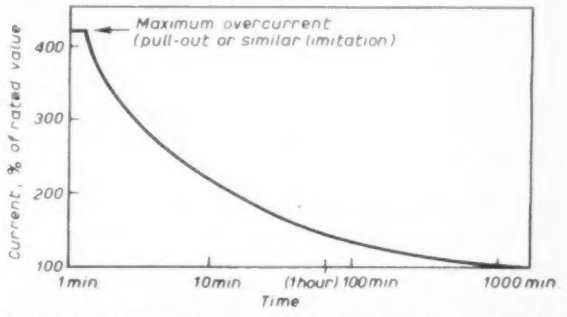
So far as I can see, there is no thermostat available, at the moment, that can be used for this purpose and it may be better to consider the use of three positive temperature coefficient thermistors connected in series with a relay. Although simple adjustment would not be possible these have the advantages of being small and, therefore, easily embedded in the winding and, unlike thermostats, they present no contact problems.

R. A. F. Craven, A.M.I.E.E.,
DIRECTOR,
WATFORD ELECTRIC AND MNFG. CO. LTD.,
WATFORD, HERTS.

* * *

I READ Mr Craven's article on motor protection with great interest and I have studied the correspondence which you published subsequently on 24 March. I feel that I must point out that in going into detail one particular point has been obscured.

The fact is that, whilst a motor complying with BS 2613 has no overload rating, it frequently has capacity to deal with loads greater than the rated load.



Curve illustrating capacity of item of apparatus to deal with currents in excess of rated current

In making the above statement, I have purposely avoided using the term "overload" because in that context it would be meaningless. To comply with BS 2613, a motor has to be capable of delivering rated output without certain limits of temperature rise being exceeded when the available cooling air is at a temperature of 40°C. Clearly, if when operating continuously with cooling air at 40°C the motor draws a current greater than the rated current, it will be overloaded, but if it is operating under less onerous conditions a current in excess of rated current will not necessarily constitute an overload.

In fact, for practical purposes, the term "overload" may be considered to have but two meanings: first, any load causing a temperature rise in excess of the permitted limit, and secondly, any load causing the machine to pull out of "synchronism."

The capacity of a piece of apparatus to deal with currents in excess of the rated current might well be illustrated by a curve of the type shown and this will emphasise that, to make the best use of a given machine, the protective device used must cope with a number of variables. In other words, if a protective device has a choice of fixed settings, the protection afforded can only be approximate if the full available capacity of the motor is to be utilised.

Some time ago, I investigated this problem for rather larger pieces of apparatus which were subjected to

fluctuating loads, and I came to the conclusion that, for complete overload protection, the following facilities had to be provided:

(1). Means of measuring the temperature of the available cooling air.

(2). A device for integrating the loads applied to the apparatus with respect to time.

(3). A device for comparing the output of (2) above with the theoretical conditions which would obtain under steady loading at the highest permissible cooling air temperature, and provide a resultant which would indicate whether the capacity of the apparatus was being fully utilised at any instant. The setting of this device to be affected by (1) above.

Early attempts to devise such a protective device met with considerable difficulties, but eventually a relatively simple device was made. Within certain limits, it would be possible to change the sensing elements of such a device so that an approximate match is obtained with the thermal time constant of the apparatus that it is desired to protect.

Whilst I do not suggest that such complete protection is economically justifiable for the smaller motors used in the normal run of applications, such protection might well prove desirable for larger machines or for very special applications (e.g., nuclear plant applications) that are now being encountered, and I should be interested to know whether other readers have attempted to approach the problem from the standpoint that I have adopted.

P. Bingley, A.M.I.E.E.,
Walton-on-Thames, Surrey.

JOINTING ALUMINIUM BUSBARS

THE importance of ensuring low contact resistance in busbar assemblies can hardly be overestimated, especially for installations where excessive voltage drop or overheating may have serious consequences. Obtaining low contact resistance is more difficult with aluminium than with copper busbars and in a recent ERA report, Z/T 118, emphasis is placed on the importance of suitable surface preparation and contact pressure.

The tests indicate that rolled aluminium busbars have lower contact resistance than extruded bars, presumably because a flatter and more uniform surface is obtained with the rolling process.

Effect of surface preparation on busbar contact resistance

Busbar material and surface preparation	Least measured contact resistance μohm/sq in. R_c	Calculated pressure to give R_c lb/sq in.
Aluminium:		
rolled, and silver plated	2·5	550
rolled, with chemical compound	3·0	2,770
rolled, and tinned	3·0	3,400
alloy, with chemical compound ...	6·0	2,700
alloy, power scratch-brushed under p.j.	11·0	2,700
rolled, with zinc, zinc oxide and p.j.	20·0	3,000
rolled, untreated	230·0	1,400
extruded, untreated	1,000·0	1,400
alloy, untreated	28·0	4,500
Copper:		
untreated	15·0	630
with chemical compound	13·0	630

Loads applied by bolted clamps give significantly higher values of contact resistances than corresponding loads exerted by a hydraulic press, probably because, even with substantial clamps, a certain amount of bending occurs, with consequent variation in pressure over the contact surface.

Silver plating and tinning give the lowest contact resistance, but they are very closely followed by surface treatment with Kynal, a compound which reacts with the aluminium oxide surface film, replacing it by a layer of zinc. A compound containing particles of zinc in petroleum jelly lowers the contact resistance of untreated joints, but is less effective than scratch-brushing of the mating surfaces under a film of petroleum jelly. The reason seems to be that, although the zinc particles bridge gaps between the two busbars, they also prevent them coming into intimate contact at any point. Compounds containing zinc oxide proved to be generally inferior to other compounds because the oxide is a bad conductor.

The theory of busbar connections given in the report is along the lines adopted in the article on "Solderless Connections" (Electrical Times, 31 March, p. 491). A bridge method was used to measure variations in contact resistance with pressure, temperature and current density. Current densities were kept constant during most of the tests, the values used being 500 A/sq in. for 4 in. by $\frac{1}{4}$ in. busbar sections and 100 A/sq in. for 8 in. by $\frac{3}{8}$ in. sections.

Contact resistance is shown to bear an inverse relationship to applied joint pressure, it is inversely proportional to contact area and is independent of current density over the range of currents used in the tests.

Installation Trio

INSTALLATION engineers and contractors will welcome three new catalogues made available by Simplex Electric Co. Ltd., of Creda Works, Blythe Bridge, Staffs. Produced in handy form, they cover, respectively, switchgear, automatic control gear and lighting equipment, and they are distinguished by the amount of descriptive matter they carry, in addition to the usual illustrations and tabulated dimensional and rating detail.

The switchgear catalogue is classified into sections according to the three main ranges Simplex offers, Star, Regent and Monarch, with further subdivision for particular types of equipment. In the automatic control gear catalogue, the break-up is by type of equipment (timers, isolators, control relays, contactors and motor starters) and rating; and a section that will doubtless prove of wide use carries tables giving approximately full-load currents for different types and efficiencies of motors. In the lighting equipment catalogue, the range covered is floodlights, industrial reflectors, local lighting, bulkhead, screwglass, fluorescent and commercial.

Highlights at Earls Court

REVIEW OF 1960 ELECTRICAL ENGINEERS' EXHIBITION

The Rt. Hon. Reginald Maudling, M.P. (President of the Board of Trade), opening the Exhibition

BIGGER, brighter, more crowded, and, if possible, more successful than ever seems to be the general consensus of opinion on the 1960 Electrical Engineers' Exhibition when the doors of Earls Court closed on Saturday evening. One of the most frequent comments to be heard was that more visitors were about than last year, a feeling more than amply supported by the attendance figures, which were well up on last year. In all, more than 75,000 people had passed through the turnstiles, well above the 68,000 or so of 1959.

Exhibitors in general seemed to be content with the turnout. Most, if not all, stands were busily occupied throughout the week, and the number of useful inquiries appeared to be as high as ever.

If anything is to be remembered of the 1960 show it is its bright atmosphere. In keeping with the thickening professional gloss, lighting seemed to be used much more this year, quite apart from the dominating electrolier. Again this feeling is borne out by statistics; the m.d.i. of the show exceeded that of the Motor Show, and as that was then the largest for any exhibition in the country, the electrical industry's show can lay claim to yet another record.

Some individual loads are quite staggering. One engineering firm with a display of semi-conductor-controlled lighting and power loads had a three-phase service of 100 amps/phase capacity. A lighting firm required to cater for a connected load of 45 kW, whilst a domestic appliance display called for a 150 amp s.p. supply which had to be specially provided. One or two more of the larger firms also went over to the two-tier stand in order to maintain their entertainment services without reducing equipment display space.

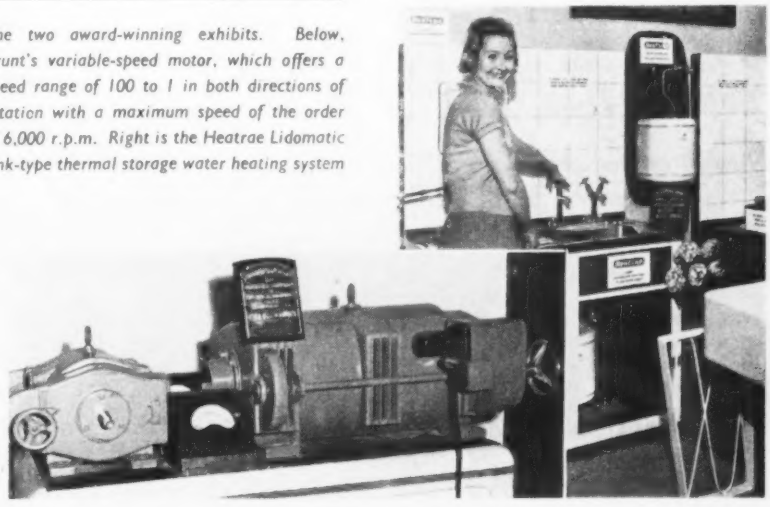
What of next year? The "theme" of signalling and communications has been suggested, although this has yet, of course, to be finally decided. The idea, we understand, is a display indicating the role of signalling and communication in three major services of this country: rail transport, road transport, and the post office. Another new feature might be a pavilion of light, more or less on the lines of that at Hanover. Again it is no more than a suggestion at present, but it would provide a compact display of the latest fittings available.

Whilst on the subject of special features, most visitors will agree that the Navy's display was first-class. It is clear that a great deal of effort had been spent in showing as comprehensively as possible the part power and light-current engineering play in the fleet. In fact, it might also be said that a veil of secrecy was lifted here and there, since some of the gear was being shown prior to being installed in ships now in building.

Another example of the established character of the exhibition is smoother organisation. On the one hand, the Exhibition Consultative Committee is being reorganised so that it may more fully represent exhibitors' interests, after having been created some 18 months ago by the BEAMA Publicity Committee. The new committee is to be of 30 members, in whose nomination and election all exhibitors are being invited to participate, the ballot being conducted by a firm of accountants. In its new form, the committee should be better able to serve its purpose of acting as a clearing house for exhibitors' comments and complaints. On the other hand, this year for the first time saw the appointment of a convener for the work of erecting the exhibition, to act as an industrial liaison officer between the trade unions, stand contractors and organisers.

Although this year's show was larger than last years by some 30 or 40 more stands, the first floor did not seem to have been all that more tightly packed to accommodate the newcomers. It is obvious, however, that the limit will be reached eventually, although there is still room for about 30 more stands, whilst maintaining a feature. If the feature is discontinued (which may not necessarily be a good thing) even more space would be available. There is also the Warwick Room on the second floor.

The overseas attraction of the exhibition continues to grow; this year there were 60% more visitors representing overseas countries than last year. The actual number involved was 889, which is, of course, so small a fraction of the total attendance that it would explain the feeling expressed here and there that not much had been seen of them, although few would doubt the value of continuing to attract as many from overseas as possible.



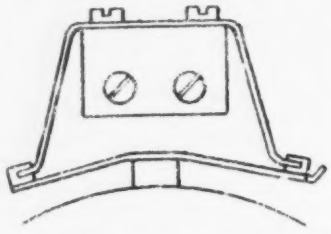
The two award-winning exhibits. Below, Brunt's variable-speed motor, which offers a speed range of 100 to 1 in both directions of rotation with a maximum speed of the order of 6,000 r.p.m. Right is the Heatrae Lidomatic sink-type thermal storage water heating system

PROGRESS IN PATENTS

SELECTED SPECIFICATIONS

Low Inertia Brush Gear

The problem of "brush bounce" on the commutators and slip-rings of high speed motors and generators is not a new one, but it has achieved greater significance in recent years in relation to the excessive brush wear experienced on aircraft electrical equipment at high altitudes. While it may not be the sole reason—the lack of moisture in rarefied atmosphere is also a contributory factor—there can be no question that the maintenance of consistent mechanical and electrical contact between brush and commutator not only reduces brush wear but also the form and amplitude of ripple on the generated supply which may have undesirable effects on electronic equipment in the vicinity.



Low inertia brush and suspension for high speed slip-rings and commutators

The Royal Aircraft Establishment has carried out a long investigation into the design of low inertia brushes and brushgear with some interesting results, details of which were published recently in an IEE paper summarised in these pages on 14 January. The arrangement there described was strictly a laboratory one involving wafer brushes maintained in contact with the commutator by air jets. A practical development arising from the same broad research is now described in specification 831,333, in the name of the Minister of Supply. Here the brush is supported on a thin leaf spring of beryllium copper held in tension by two short, stiff spring arms. Since the lateral movement of the spring arms will be small for appreciable vertical movement of the brush, which is of small mass and inertia, close and consistent contact with the slip-ring or commutator can be maintained over variations in diameter through a "high bar" or significant degree of eccentricity of the traversed path.

Zone Refining Techniques

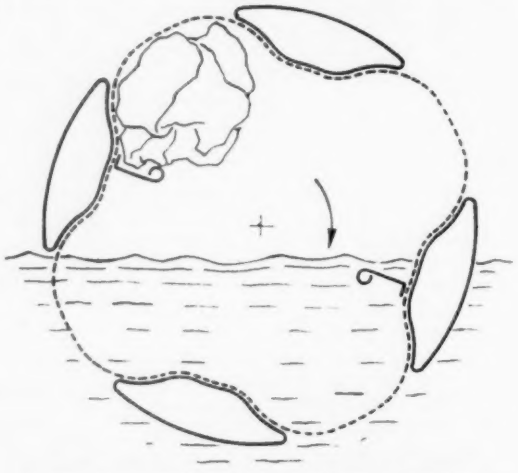
So rapid has been the development of technical processes in connection with semiconductor production that patent specifications now being published, and for which the original application was filed four or five years ago, detail methods that are already commonly accepted practice. It may sometimes be forgotten that many of these processes are protected and their use without reference to the patentees is to court action for infringement.

Specifications for a number of zone refining processes which have just been published come within this category and include 831,303 and 831,304 in the name of Standard Telephones, dealing with the treatment of silicon, and 831,305 in the name of AEI, dealing with the treatment of the heavy metals more usually associated with nuclear reactors. In regard to the former, it is well known that methods suitable for germanium, in which the metal is carried through the heating zone in a carbon or silica boat, are totally unsuited to silicon because it reacts with both materials at the refining temperatures. This patent covers the method whereby a localised zone on a rod of unrefined silicon is heated and then, by rotating and traversing the rod, made to travel along it carrying the impurities, the unheated portions forming the supporting structure meanwhile.

In regard to the AEI specification, this deals with the refinement of heavy metals which have undergone fission in which the rod for treatment is enclosed with a sheath of higher melting point material and/or to which has been added an absorbent of the metals to be removed.

Tumbler Washing Machines

The tumbler type washing machine in which the washing cylinder is rotated on a horizontal axis with only partial immersion in the washing liquid imposes considerable wear on both the bearings and the drive. In specification 831,467, attributed to the English Electric Co., bulges on



A tumbler type washing cylinder with buoyancy chambers

the cylinder accommodate buoyancy chambers which, when submerged in the washing liquid, relieve much of the dead weight on the bearings. The bulges on the inner surface form pockets which trap the clothes during rotation to lift them clear of the liquid and to tumble them back again, the pockets being supplemented by vanes which serve to redistribute the clothes during the washing action. It is claimed that by rounding the leading edge of the vanes and suitably proportioning the length, the clothes lifting capacity of the recesses is improved.

Reproduced by permission of the Controller of H.M. Stationery Office. Copies of specifications may be obtained from the Patent Office (Sales Branch), 25 Southampton Bldgs, W.C.2. Price 3s 6d.

D.C. submarine cable again recommended for N.Z.

CONSULTANTS SUPPORT H.V. D.C. FOR COOK STRAIT

A DIRECT-CURRENT submarine cable link between New Zealand's North and South Islands is the recommendation of British consultants, Preece, Cardew and Rider, as the best way of transmitting power from the Benmore power station in South Island to Wellington in North Island. The consultants had been commissioned to investigate the problem following criticisms of the report of an official NZ committee in 1957, which proposed a scheme broadly similar to that now recommended. The route suggested was under attack, and there was doubt about the suitability of h.v. d.c. for a transmission link so important to New Zealand's economy.

The consultants conclude from an exhaustive examination of many aspects of the problem, that the scheme put forward in the 1957 report is the simplest and most economic proposal for the purpose in view. This they endorse, a d.c. submarine cable operating at about 500 kV (250 kV to earth), and of 600 MW capacity, and also the route then suggested, from Fighting Bay (South Island) to Oteranga Bay (North Island). In the course of their study, they considered alternative schemes, but cost considerations were £8 million (30%) in favour of the d.c. scheme (Table 1) and the consultants endorse it as "one which is practicable to construct and will be reliable in operation."

The arguments underlying the recommendations are summarised at length in the "conclusions" section of the report submitted to the NZ Electricity Dept. The cost consideration comes first, but there follows the essential engineering argument. Although the h.v. d.c. scheme proposed employs a higher voltage and is larger in capacity than any similar project now being operated or constructed outside Russia, it is considered that sufficient progress has been made in the development and application of apparatus, lines and cables to justify a belief in its practicability. There will be problems particular to New Zealand which will require a new approach, but it is confidently believed that adequate engineering solutions to these will be found.

Advantages of D.C.

An important factor in recommending d.c. is that the power can be transmitted across the Cook Strait by three submarine cables (two active, one spare) compared with a minimum of 11 (two spare) with a.c. This greatly simplifies the installation problems, which are considerable in this locality. One factor is the need to space each cable at least 1,000 yd from its neighbour. If this had to be done with 11 cables, laying in "excessive depths" might be necessary.

Although installation of the power cables in the Cook Strait will undoubtedly be a difficult operation "past experience and expert opinion combine to indicate that these difficulties can be overcome with complete satisfaction." If a cable should break-down, repair should be possible. The consultants are of the opinion that past unsatisfactory experience with telegraph cables in this area is not directly applicable to larger, heavier and more robust power cables. They are less definite in their endorsement of the much-criticised Fighting Bay—Oteranga route, which is the shortest practicable; they think it would be advisable to investigate as well an alternative longer route from Fitzroy Bay to Cloudy Bay.

Returning to the question of a.c. or d.c., the point is strongly made that use of a d.c. link will facilitate system operation, because of the ease of control of power transfer it will make possible, and because, in its provision of an asynchronous tie, the need for accurate synchronisation of the two Island power systems is avoided. There is a look at the Swedish Gotland submarine cable installation, with the comment that it indicates that a d.c. connection may be rather more prone to disturbances than would an a.c. connection, especially in the terminal assemblies; but not seriously so.

Table 1. Comparative costs of alternative schemes.

S. Island line	Cable	Cost £ million
400 kV a.c.	110 kV a.c.	28.27
500 kV d.c.	500 kV d.c.	18.80
400 kV a.c.	500 kV d.c.	25.35
400 kV a.c.	150 kV a.c.	26.68

500 kV d.c. circuits are 250 kV to earth. The S. Island line is 320 miles long; the crossing 25 miles, with connecting o.h. lines of 15 miles (S. Island) and 25 miles (N. Island)

It is recommended in the report that because of the remoteness of New Zealand from major manufacturing centres, a clause should be inserted in cable and converter contracts, requiring a special maintenance period of three years, with an engineer stationed in N.Z.

Time Scale

It is suggested in the report that the cables might be laid by early 1964, and the first 300 MW of terminal equipment ready for operation in July of the same year. To permit this timing to be attained, investigational work ought to begin at once, with suppliers nominated by the middle of the present year. If the 1964 date is met, then accidental or other troubles should be cleared by early 1965.

In a statement coinciding with release of the report in New Zealand, the Minister of Electricity is reported to have commented that the Government's responsibility now is not so much to decide whether the cable is to be laid, as to anticipate the most appropriate time for putting the project into effect. The consultant's report, he said, would be studied by the New Zealand Power Planning Committee, which would submit recommendations to Parliament when the next session opened on 22 June. Since the proposal was originally advanced, there had been new thoughts about the potentialities of the North Island's own power resources and new thought as well about possible industrial expansion in South Island.

We are indebted to Messrs Preece, Cardew and Rider for facilities to summarise their recommendations.

OVERSEAS NEWS

from our correspondents abroad

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Export Possible

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N. RHODESIA

Plant Inauguration

Kasama hydro-electric station, on the Luombe River in the Northern Province of Northern Rhodesia, will be officially opened on 20 April by Mr W. G. Dunlop, the Protectorate's Minister of Transport and Works. One of three such projects now nearing completion in the Northern and Luapula Provinces, the Kasama station has been in operation since last December. These three hydro-electric undertakings are being financed and constructed by the N. Rhodesian Government from funds set aside for electrical development. They complement special development in the northern provinces from a special loan to the Government by the Rhodesian Selection Trust. Other rural electricity schemes, dependent upon diesel plant, are also being developed. Kasama power station is located at Chishimba Falls, some 20 miles from Kasama Township to which a 33 kV line runs. A low diversion weir has been built between the upper and main falls. Initial firm capacity is 600 kW. Construction work has been divided into three main contracts. The site civil engineering works, including diversion weir, canal, penstock and power station, have been undertaken by Richard Costain (Central Africa) Ltd. Electrical reticulation, including the main 33 kV transmission line, 11 kV distribution and 380/220 V local network has been carried out by Clough Smith and Co. (Central Africa) Ltd. Three 300 kW water turbines have been provided by Gilbert Gilkes and Gordon, with the alternators supplied by Bruce Peebles and Co. Switchgear is by A. Reyrolle and the transformers by Denis Ferranti. Consulting engineers for the project were Merz and McLellan (Rhodesia) in association with F. E. Kanthack and Partners, who were responsible for civil engineering work. The scheme has been executed under the general direction of Mr W. Le Page, M.I.E.E., M.RHOD.I.E., chief electrical adviser to the Ministry of Transport and Works, N. Rhodesia.

LIBERIA

Power Concession

A concession to establish a new thermal power station and a hydro-electric plant has been granted to a newly formed Liberian National Electric Corporation. The thermal station, of 6,000 kW capacity, is to be in operation next year, while the hydro station, to have three 10,000 kW sets, is scheduled for commissioning by 1968. The new corporation is to be financed to the extent of 75% by private capital and the remainder by the Liberian Government, who guarantee payment for the projects up to $30 million. Under the concession, the Government will take 50% of profits derived from the scheme. Placing of contracts is in the hands of Mr A. Newman, a Belgian banker, who is president of the Corporation, and of his associate, Mr D. Zetland, in London. It is expected that the contracts will be let in the next few weeks, we understand.

S. AFRICA

Traction Order

Further details have now been released of the £2¾ million order for electric traction equipment for South Africa, recently received by Associated Electrical Industries Ltd., to which we referred on 24 March. The order is for traction motors, control gear, and lighting and heating equipment, for installation in 113 motor coaches to be built for South African Railways by Union Carriage and Wagon Co. (Pty) Ltd., to whom AEI will be principal sub-con-

tractors. The motor coaches will operate at 3,000 volts d.c., and will be used to supplement and extend existing suburban and inter-urban services of the Cape Western and Reef sections of the line. They will multiple with the 105 coaches supplied to the Reef during 1957-59; the latter were AEI equipped, and only minor changes will be made in the design of the new equipment. Among interesting features of design is the ventilation of the main traction motors. The Reef coaches operate at an altitude of 6,000 ft and to ensure adequate cooling of the motors, they are not only self-ventilated, but are also fitted with axial-blow fans to provide additional cooling under heavy-load conditions. Motors and motor-generator sets will be insulated for Class H temperature rises. All high voltage switchgear will be located in a pressurised cubicle in the body of each coach. Filtered air is blown into the cubicle; this effectively excludes dirt and dust, giving greatly increased periods between overhauls and preventing tracking of the insulation.

INDIA

Pipeline Plant

A contract valued at over £600,000 for diesel engines, dual-fuel engines and diesel-engine driven generating sets, with associated switchgear for a crude oil pipeline project in Northern India, has been placed with W. H. Allen, Sons and Co. Ltd. The plant is for Oil India Ltd. A total of 51 Allen engines are to be supplied, 30 for pumping duties in nine stations and 21 for electricity generation in seven power stations. The units required for the latter consist of three five-cylinder, 360 b.h.p., nine four-cylinder, 286 b.h.p., and nine three-cylinder, 219 b.h.p. four-stroke engines which will drive Allen self-regulating alternators having power outputs of 250 kW, 196 kW and 150 kW, respectively. The control equipments in the seven power stations will be designed and built by Brookhirst Igranic Ltd., under a sub-contract amounting to nearly £60,000. Each station will contain one composite BHI control board incorporating control equipment for the diesel-alternator sets, and distribution for all power and lighting services, including the auxiliary pump motors, diesel engine auxiliaries and motorised valves. Three diesel-alternator sets will be installed in each station and the BHI equipment will enable any pair to be paralleled at any time, the starting of the alternators and pumps depending on the signals received from the telemeter circuits. Motorised flow valves in the input and output side of each station will enable the station to be by-passed by the flow of oil, for example in emergency, through control from the next station on either side. To achieve this, each BHI control board will incorporate remote and local switching devices. This crude oil pipeline is claimed to be the largest project of its kind in the world at the present time. The pipeline is designed to transport crude oil from the developing Nahorkatiya field in upper Assam to refineries at Gauhati in Assam and Barauni in the State of Bihar, a distance of 720 miles.

NEW ZEALAND

Plant for Benmore

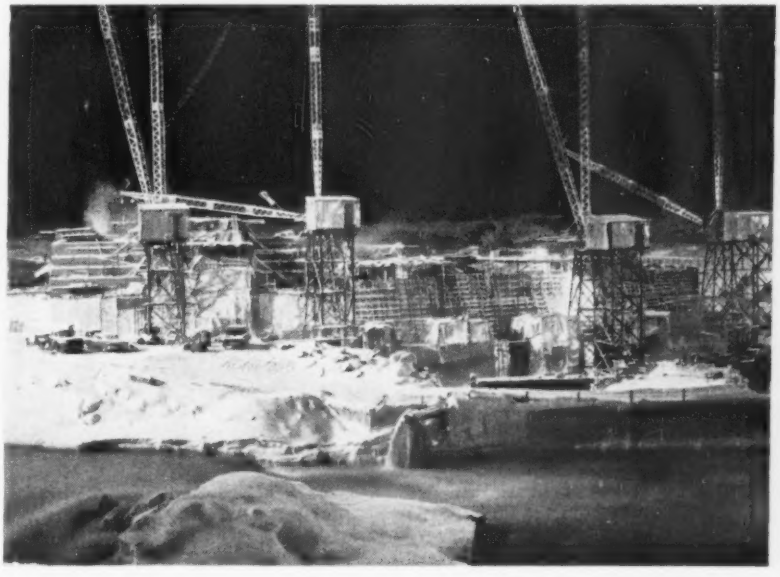
Tenders are now being called for the supply of the six generators for the Benmore hydro-electric plant, Mr Watts, the NZ Minister of Electricity, stated recently. He indicated that the orders would be for the entire group of six 90 MW machines or, alternatively, for the provision of two only by any one manufacturer. To be built on the Waitaki River in South Island, the project involves construction of an earth dam with a crest 2,000 ft from abutment to abutment. The turbines will operate on a head of 305 ft. It is hoped to have the first machine in operation by April, 1965, and the second a few months later.

Geothermal Expansion

Further expansion in the geothermal steam investigation programme, involving the expenditure of about £1 million during the next five years, has been announced by the New Zealand Minister of Electricity, Mr H. Watt. The investigations are to be mainly at Wairakei, and elsewhere as the Government approves. For a full assessment of the possibilities of developing the Wairakei region and harnessing its geothermal energy for electricity production, more information is needed. The outlay will ultimately mean savings for power consumers, he stated. It is estimated that the cost per unit of net output from the Wairakei power station, when operating at its proposed maximum capacity of about 250 MW, will be below that of many of the hydro stations now building or under consideration. The estimated cost per unit of net output from Wairakei is 0·34d, which compares with 0·439d for the Matahina project and 0·446d for the Cook Strait cable proposal, he said. The programme is in addition to the £3 million hydro-electric power investigation plan approved by the Government last Aug.

460 kV TRANSMISSION FOR ONTARIO

Sub-zero temperatures and snow are not permitted to hinder round-the-clock construction at the Otter Rapids project of the Hydro Electric Power Commission of Ontario. Our picture alongside shows the diversion port area with the downstream coffer dam on the right. Output of 90 MW from two generators is scheduled for 1961 and ultimate capacity of 172 MW by 1963. Power from this station will feed into a new e.h.v. system which will also be served by the three new hydro-electric projects for north-eastern Ontario, to which we referred last week. Power will be transmitted at 230 kV to a new terminal station near the existing Abitibi Canyon generating plant, about 230 miles north of Sudbury. The line from this gathering point to the Sudbury area is scheduled for service in 1963, along with the first Mattagami plant (referred to last week) and units 3 and 4 at Otter Rapids. It will be designed for 460 kV, but will operate at 230 kV until the second Mattagami station starts up in 1965. The e.h.v. line south from Sudbury will be designed to operate initially as a double-circuit 230 kV line with provision to change later to a 460 kV s.c. line



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N. RHODESIA

Plant Inauguration

Kasama hydro-electric station, on the Luombe River in the Northern Province of Northern Rhodesia, will be officially opened on 20 April by Mr W. G. Dunlop, the Protectorate's Minister of Transport and Works. One of three such projects now nearing completion in the Northern and Luapula Provinces, the Kasama station has been in operation since last December. These three hydro-electric undertakings are being financed and constructed by the N. Rhodesian Government from funds set aside for electrical development. They complement special development in the northern provinces from a special loan to the Government by the Rhodesian Selection Trust. Other rural electricity schemes, dependent upon diesel plant, are also being developed. Kasama power station is located at Chishimba Falls, some 20 miles from Kasama Township to which a 33 kV line runs. A low diversion weir has been built between the upper and main falls. Initial firm capacity is 600 kW. Construction work has been divided into three main contracts. The site civil engineering works, including diversion weir, canal, penstock and power station, have been undertaken by Richard Costain (Central Africa) Ltd. Electrical reticulation, including the main 33 kV transmission line, 11 kV distribution and 380/220 V local network has been carried out by Clough Smith and Co. (Central Africa) Ltd. Three 300 kW water turbines have been provided by Gilbert Gilkes and Gordon, with the alternators supplied by Bruce Peebles and Co. Switchgear is by A. Reyrolle and the transformers by Denis Ferranti. Consulting engineers for the project were Merz and McLellan (Rhodesia) in association with F. E. Kanthack and Partners, who were responsible for civil engineering work. The scheme has been executed under the general direction of Mr W. Le Page, M.I.E.E., M.RHOD.I.E., chief electrical adviser to the Ministry of Transport and Works, N. Rhodesia.

LIBERIA

Power Concession

A concession to establish a new thermal power station and a hydro-electric plant has been granted to a newly formed Liberian National Electric Corporation. The thermal station, of 6,000 kW capacity, is to be in operation next year, while the hydro station, to have three 10,000 kW sets, is scheduled for commissioning by 1968. The new corporation is to be financed to the extent of 75% by private capital and the remainder by the Liberian Government, who guarantee payment for the projects up to $30 million. Under the concession, the Government will take 50% of profits derived from the scheme. Placing of contracts is in the hands of Mr A. Newman, a Belgian banker, who is president of the Corporation, and of his associate, Mr D. Zetland, in London. It is expected that the contracts will be let in the next few weeks, we understand.

S. AFRICA

Traction Order

Further details have now been released of the £2¾ million order for electric traction equipment for South Africa, recently received by Associated Electrical Industries Ltd., to which we referred on 24 March. The order is for traction motors, control gear, and lighting and heating equipment, for installation in 113 motor coaches to be built for South African Railways by Union Carriage and Wagon Co. (Pty) Ltd., to whom AEI will be principal sub-con-

tractors. The motor coaches will operate at 3,000 volts d.c., and will be used to supplement and extend existing suburban and inter-urban services of the Cape Western and Reef sections of the line. They will multiple with the 105 coaches supplied to the Reef during 1957-59; the latter were AEI equipped, and only minor changes will be made in the design of the new equipment. Among interesting features of design is the ventilation of the main traction motors. The Reef coaches operate at an altitude of 6,000 ft and to ensure adequate cooling of the motors, they are not only self-ventilated, but are also fitted with axial-blow fans to provide additional cooling under heavy-load conditions. Motors and motor-generator sets will be insulated for Class H temperature rises. All high voltage switchgear will be located in a pressurised cubicle in the body of each coach. Filtered air is blown into the cubicle; this effectively excludes dirt and dust, giving greatly increased periods between overhauls and preventing tracking of the insulation.

INDIA

Pipeline Plant

A contract valued at over £600,000 for diesel engines, dual-fuel engines and diesel-engine driven generating sets, with associated switchgear for a crude oil pipeline project in Northern India, has been placed with W. H. Allen, Sons and Co. Ltd. The plant is for Oil India Ltd. A total of 51 Allen engines are to be supplied, 30 for pumping duties in nine stations and 21 for electricity generation in seven power stations. The units required for the latter consist of three five-cylinder, 360 b.h.p., nine four-cylinder, 286 b.h.p., and nine three-cylinder, 219 b.h.p. four-stroke engines which will drive Allen self-regulating alternators having power outputs of 250 kW, 196 kW and 150 kW, respectively. The control equipments in the seven power stations will be designed and built by Brookhirst Igranic Ltd., under a sub-contract amounting to nearly £60,000. Each station will contain one composite BHI control board incorporating control equipment for the diesel-alternator sets, and distribution for all power and lighting services, including the auxiliary pump motors, diesel engine auxiliaries and motorised valves. Three diesel-alternator sets will be installed in each station and the BHI equipment will enable any pair to be paralleled at any time, the starting of the alternators and pumps depending on the signals received from the telemeter circuits. Motorised flow valves in the input and output side of each station will enable the station to be by-passed by the flow of oil, for example in emergency, through control from the next station on either side. To achieve this, each BHI control board will incorporate remote and local switching devices. This crude oil pipeline is claimed to be the largest project of its kind in the world at the present time. The pipeline is designed to transport crude oil from the developing Nahorkatiya field in upper Assam to refineries at Gauhati in Assam and Barauni in the State of Bihar, a distance of 720 miles.

NEW ZEALAND

Plant for Benmore

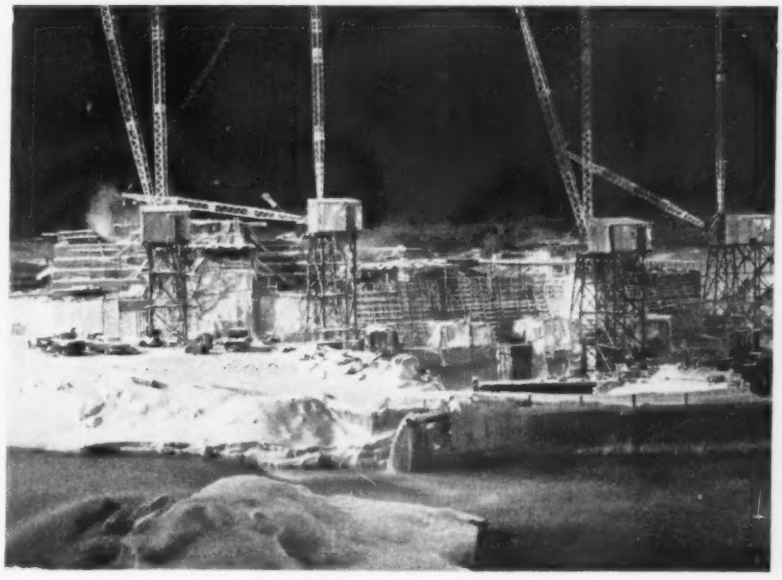
Tenders are now being called for the supply of the six generators for the Benmore hydro-electric plant, Mr Watts, the NZ Minister of Electricity, stated recently. He indicated that the orders would be for the entire group of six 90 MW machines or, alternatively, for the provision of two only by any one manufacturer. To be built on the Waitaki River in South Island, the project involves construction of an earth dam with a crest 2,000 ft from abutment to abutment. The turbines will operate on a head of 305 ft. It is hoped to have the first machine in operation by April, 1965, and the second a few months later.

Geothermal Expansion

Further expansion in the geothermal steam investigation programme, involving the expenditure of about £1 million during the next five years, has been announced by the New Zealand Minister of Electricity, Mr H. Watt. The investigations are to be mainly at Wairakei, and elsewhere as the Government approves. For a full assessment of the possibilities of developing the Wairakei region and harnessing its geothermal energy for electricity production, more information is needed. The outlay will ultimately mean savings for power consumers, he stated. It is estimated that the cost per unit of net output from the Wairakei power station, when operating at its proposed maximum capacity of about 250 MW, will be below that of many of the hydro stations now building or under consideration. The estimated cost per unit of net output from Wairakei is 0·34d, which compares with 0·439d for the Matahina project and 0·446d for the Cook Strait cable proposal, he said. The programme is in addition to the £3 million hydro-electric power investigation plan approved by the Government last Aug.

460 kV TRANSMISSION FOR ONTARIO

Sub-zero temperatures and snow are not permitted to hinder round-the-clock construction at the Otter Rapids project of the Hydro Electric Power Commission of Ontario. Our picture alongside shows the diversion port area with the downstream coffer dam on the right. Output of 90 MW from two generators is scheduled for 1961 and ultimate capacity of 172 MW by 1963. Power from this station will feed into a new e.h.v. system which will also be served by the three new hydro-electric projects for north-eastern Ontario, to which we referred last week. Power will be transmitted at 230 kV to a new terminal station near the existing Abitibi Canyon generating plant, about 230 miles north of Sudbury. The line from this gathering point to the Sudbury area is scheduled for service in 1963, along with the first Mattagami plant (referred to last week) and units 3 and 4 at Otter Rapids. It will be designed for 460 kV, but will operate at 230 kV until the second Mattagami station starts up in 1965. The e.h.v. line south from Sudbury will be designed to operate initially as a double-circuit 230 kV line with provision to change later to a 460 kV s.c. line



Personalities *in the industry*

Mr H. B. Campbell

Lt-Col H. E. A. Donnelly

Mr C. G. Hickling

Mr K. C. Hibbert

Mr J. W. Ringrose

A project engineer to the Southern Project Group, CEGB, **Mr H. B. Campbell,** A.M.I.MECH.E., M.INST.F., has been promoted to assistant chief project engineer with that Group (*ESH, page 51). He was generation engineer (construction) with the Eastern Division, CEGB, prior to the establishment of the establishment of the Project Group. This followed over three years as station superintendent at the Division's Cliff Quay power station. Mr Campbell received his early training with the East Anglian Electric Supply Co. Ltd. and the Ipswich Corporation Electric Supply and Transport Departments. He subsequently became a technical assistant in the generating department of the Corporation in 1924, and served successively as construction assistant, assistant power station superintendent, personal assistant to the chief engineer and manager, and chief assistant engineer. On the establishment of the BEA in 1948 he became a senior executive officer of the Eastern Division and in September of that year went to Cliff Quay power station.

For health reasons, **Mr E. Nobbs** has indicated that he wishes to relinquish the position of joint managing director and secretary of Watford Electric and Manufacturing Co. at the end of this year. He has agreed to act as a part-time executive director for a further year. **Mr R. G. Smith,** at present joint managing director and sales director, will, from next year, continue as sole managing director. **Mr M. G. Jones,** now deputy sales director, will succeed Mr Smith as sales director as from 1 July next. It is proposed to appoint **Mr B. W. H. Swabey,** A.C.A., at present joint assistant secretary, to succeed Mr Nobbs as the company's secretary at a suitable date in the current year.

Mr W. J. Walpole has been appointed managing director of Lumenated Ceilings Ltd., a member of the Hall-Thermotank group. Mr Walpole has been with Lumenated Ceilings Ltd. since the company was formed in 1954 to introduce luminous ceilings into the UK. He has been a director since January, 1958.

Assistant secretary (personnel) with the Yorkshire Electricity Board since 1953, **Lt-Col H. E. A. Donnelly,** M.C., T.D., A.M.B.I.M., has been appointed personnel officer to the Southern Electricity Board, with effect from 16 May. (*ESH, pages 91/141). Before joining the Yorkshire Board he was staff officer of the Northmet sub-area of the Eastern Electricity Board. He started with the old Northmet Power Co. in 1930, subsequent holding various positions.

British Insulated Callender's Cables Ltd. announce that **Mr C. G. Hickling,** A.M.I.E.E., has been appointed manager of their Middlesbrough branch in succession to **Mr G. W. Wheaton** who has taken up an appointment at their Prescot works. Mr Hickling received his electrical training at Loughborough College and subsequently with the Loughborough Corporation Electric Supply Department. There followed a six-year period of war service as Lieut-Commander in the electrical branch of the RNVR. Mr Hickling joined the Wiring Development Department of BICC in 1947. He transferred to the Birmingham sales office in 1954 and three years later moved to Middlesbrough.

Formerly station superintendent at Watford generating station, **Mr K. C. Hibbert,** M.INST.F., has been appointed to a similar post at the Eastern Division's Peterborough power station (*ESH, page 55).

Mr Douglas Stewart, electrical engineer for the No. 2 (Cramlington) Area of the Northern (N. and C.) Coal Board, has been appointed the board's Divisional electrical engineer. Mr Stewart started work as an apprentice electrician with the Sheffield Coal Co. He has served as electrical instructor in the mining mechanisation centre at Sheffield, unit engineer at Prince of Wales Colliery, Pontefract, and sub-area electrical engineer in the Grimethorpe area. He took up his appointment at Cramlington in 1957.

Mr J. W. Ringrose, with the Plessey organisation since 1951, has been appointed chief applications engineer of Semiconductors Ltd. He will take charge of the company's Applications Laboratory which is being expanded. After leaving the RAF in 1948, Mr Ringrose was seconded from the British Rayon Research Association to Birkbeck College, University of London, to work on electronic digital computers. In 1951 he joined the Plessey Co. Ltd. as a senior development engineer and worked on digital systems, computers and the study of commercial data processing problems. During the past few years he has been concerned with the use of transistors in many commercial and Government projects.

Sir Ivan Stedeford, chairman of Tube Investments Ltd., has been named chairman of a four-man advisory board set up by the Ministry of Transport to examine the structure, finance and working of the organisation of the British Transport Commission, and to advise on the desired urgent reorganisation.

Inventor of the "Megger" earth tester, **Mr C. E. Perry,** chief design engineer of Evershed and Vignoles Ltd., retired on 31 March after 48 years' service with the company. Mr Perry joined the Naval Division of Evershed's in 1912 to work in conjunction with Mr Sidney Evershed, founder of the firm and pioneer of the famous range of "Megger" testing instruments. He was engaged on the design and development of the gun controls used by the British Navy on major and secondary armament. In subsequent years Mr Perry took control of various instrument departments and had a great deal of influence over the development and design of the present series of Megger instruments. In this time, too,

**Denotes revision to the "Electricity Supply Handbook, 1960."*

he invented the "Dionic" water purity testing equipment and the "Megger" earth tester. To mark his retirement, he was presented with a portable typewriter by **Mr M. Vines,** joint managing director.

As we briefly noted last week **Mr G. M. Holland,** M.I.E.E., A.M.B.I.M., has been appointed engineer for Essex sub-area of the Eastern Electricity Board in succession to **Mr E. A. Cullen,** M.I.E.E., who is shortly retiring (*ESH, pages 107-8). Born in Croydon and educated at the Stanley Technical School and the Polytechnic in London, Mr Holland became an engineering student with the Croydon Corporation electricity department and later held various engineering appointments there, ultimately as assistant distribution engineer. In 1947 he went to the Peterborough electricity department as a technical assistant and within a year was appointed technical engineer to the newly formed Eastern Electricity Board. He was the planning and development engineer for the Fens sub-area for eight years from 1948 and in 1956 was appointed the sub-area engineer. Mr Cullen joined the Mersey Power Co. as technical assistant, following war service. After spending three years as district engineer at Runcorn, he became progressively assistant mains engineer, mains engineer and distribution engineer to the company. On nationalisation of the industry, he was appointed district engineer for Runcorn, Widnes and Ellesmere Port areas with the Merseyside and North Wales Electricity Board. Mr Cullen is not leaving the electrical industry—he is taking up a new position with Pye Electric Ltd. as eastern area manager. The latter concern, one of the Pye group, supplies s.c.a. conductors and distribution transformers.

Mr H. T. Ransley, A.M.I.E.E., has been appointed to succeed Mr G. M. Holland as engineer of the Fens sub-area of the Eastern Electricity Board (*ESH, page 108). Born and educated in London, Mr Ransley received his early training with G. V. Twiss and Partners, consulting engineers to British Power and Light Corporation. From 1933 to 1945 he was distribution engineer of the East Suffolk Electricity Distribution Co. Ltd. He was then appointed distribution superintendent of the Scottish Southern Electricity Co. Ltd. which covered a large area in the Border country. In 1947 he was appointed chief assistant of that undertaking and on nationalisation became section head (operation and maintenance) in the chief engineer's department of the S.E. Scotland Electricity Board. Since 1949 he has been senior assistant engineer in the development section of the chief engineer's department of Eastern Electricity Board.

Lord Nelson of Stafford, chairman of the English Electric group, was formally introduced into the House of Lords on Wednesday last week. His sponsors were Lord Mills (left), Paymaster-General, and Lord Citrine (right)

Thorn Electrical Industries announce the appointment of **Mr C. E. Singer** as general manager of George Forrest and Son Ltd. Mr Singer will also retain his present position as technical sales manager of Tricity Cookers Ltd. He first joined Tricity Cookers Ltd. in 1946 when it was controlled by the County of London Electric Supply Co. and was appointed technical sales manager in 1957.

Mr F. C. W. Clark, A.M.I.E.E., has been appointed engineer of the Lanarkshire area of the Eastern Electricity Board—he is at present deputy engineer in that area. **Mr W. Hunter,** B.L., has been appointed secretary of that board's Stirling area—he is now secretary of the Dumfries and Galloway area (*ESH, pages 166/9/170).

General manager of the Installation Equipment Division of the General Electric Co. Ltd., since 1958, **Mr J. Lawrence** has retired after 39 years' service with the company. After war service he joined the Express Lift Co. at its Greycoat St Works in Westminster in 1921, and three years later became manager of that company's Birmingham branch. In 1930 he transferred to the GEC Birmingham branch. From 1939 to 1945 he was assistant manager for Scotland based at Glasgow. Moving to Manchester in 1945, Mr Lawrence became assistant manager of the north west area. He held that post until 1945 when he moved to head office in London to take over as manager of the Switchgear and Instrument Department.

Mr L. C. Lebar, ASSOC.BRIT.I.R.E., has now joined the Electronic Machine Co. Ltd. as project and technical sales engineer. He gained many years' experience whilst with Burndept Ltd., the Gramophone Co. Ltd. and S. H. Muffett Ltd. during the course of which he has spent some 35 years in the electronic engineering field.

Southern branch representative to Marryat and Scott Ltd., **Mr H. L. Nathan** has retired. The company have appointed **Mr J. A. Conyers** to manage the area from the regional headquarters at Brighton.

Aiton and Co. Ltd. announce the appointment of **Mr R. H. Weston** as area manager for Scotland. **Mr K. H. Ewen** succeeds Mr Weston as works manager at the Derby works, and **Mr J. M. G. Lockhead** has been appointed assistant marine representative.

We are now able to reproduce below the portrait of **Mr D. W. Parkes,** whose new appointment as sales promotion manager of Tricity Cookers Ltd. we noted last week. Mr Parkes was previously sales manager, London and the South, after two years as Southern area manager.

Following the appointment of **Mr H. C. Spear** as chief personnel officer of the CEGB, the Personnel Department has been reorganised and the following appointments have been made: **Mr I. G. Ellis,** M.B.E., LL.B., F.C.C.S., A.M.B.I.M., becomes assistant chief personnel officer; **Mr N. Berryman,** M.B.E., becomes personnel officer (headquarters); **Mr E. D. Selby Lowndes,** D.F.H.,

Mr G. M. Holland

Mr E. A. Cullen

Mr H. T. Ransley

Mr C. E. Singer

Mr D. W. Parkes

A.M.I.E.E., becomes personnel officer (policy); and **Mr J. F. G. Bland,** B.A.(ECON.), A.M.I.P.M., becomes assistant education and training officer (policy) (ESH, page 49). Mr Ellis has been with the Supply Industry since 1951, when he was employed by the South Wales Electricity Board. In 1955 he was appointed as an administrative officer by the Central Electricity Authority and became personnel officer to the board in 1958. Mr Berryman joined the Industry in 1932. He was responsible for the Personal Welfare Services of the CEA and was appointed as assistant personnel officer to the board in 1958. Mr Selby Lowndes was employed by Edmundsons Electricity Corporation from 1942 to 1948. He joined the BEA in 1948 and has been a principal assistant since 1950. Mr Bland, who has been with the Industry since 1950, was employed by the Southern Division of the BEA until 1955, when he was appointed as a principal assistant in the Education and Training Branch of the CEA.

Mr R. Woolliscroft has been appointed group personnel officer to Metal Industries Ltd.

Air Marshal Sir Raymund G. Hart, director, Radio Industry Council, has taken over the functions of secretary to the Council in succession to **Mr G. B. Campbell** whose duties as secretary, Radio Industry Exhibitions Ltd., no longer allow time to act in his former capacity with the Council.

Mr B. S. Bass, previously sales manager, has been elected to the board of Dewrance and Co. as sales director. **Mr J. W. Plowman** has resigned from the board for reasons of health.

Mr A. E. Jones has been appointed a director of Rhodesian Cables. **Mr G. H. Chaloner** has resigned from the board.

Mr J. A. K. Bowerman, A.M.I.E.E., formerly district engineer at St. Albans, whose appointment as district manager at Tottenham in succession to Mr F. G. Bromley we briefly noted in our 10 March issue, served with the Guildford and Lincoln Corporation undertakings before joining the Northmet Co. as assistant engineer at Tottenham in 1938. During the war he was engaged upon research work for the Admiralty subsequently returning to Tottenham district as first assistant district engineer. At the end of 1950 Mr Bowerman was appointed to a similar post at St. Albans and became district engineer some three and a half years later. At St. Albans, Mr Bowerman has taken a major and very successful part in the electrical development of the new town at Hatfield as well as meeting the requirements of a rapidly expanding locality. In 1958 he attended a management course at the Electricity Council's Training Establishment at Buxton and in order to obtain a wider knowledge of area operations worked in the chief engineer's department at Wherstead for a period in 1959.

Mr J. A. K. Bowerman

Mr J. F. Skipsey

Mr J. F. Skipsey, B.SC., M.I.E.E., whose appointment as a member of the North Eastern Electricity Board while continuing to serve as manager of the board's Tyne sub-area we briefly noted last week, has been associated with electricity supply in the north east throughout his career. He held various appointments in the Construction Department of the Power Dept. of the North Eastern Electric Supply Co. until 1936 when he became assistant to the chief electrical engineer of the company.

Mr W. A. Collins has joined the Electric Construction Co. Ltd. as sales engineer attached to the East Midlands area offices at Sheffield. He served his apprenticeship with Laurence Scott and Electro-motors Ltd., joining Brush Electrical Engineering Co. Ltd., in 1954 as sales engineer for East Midlands, the position which he vacates to join ECC.

Mr W. Innes has been appointed chief accountant of Avo Ltd.—one of the Metal Industries group.

Mr D. L. Tabraham (General Electric Co. Ltd.) has been re-elected President of the Electric Light Fittings Association for a third year. The following have been elected chairmen of their respective Sections of the Association: Industrial and Commercial Section, **Mr T. S. Jones** (Crompton Parkinson Ltd.); Street Lighting Section, **Mr W. T. Souter** (Holophane Ltd.); and Domestic Section, **Mr L. A. Fickling** (Linolite Ltd.).

Bailey Meters and Controls Ltd. announce the appointment of **Mr V. A. Plumley,** ASSOC.M.INST., GAS.E., M.S.I.T., M.I.C.S.S.A., as manager of the Bailey Meter Division of Steam and Mining Equipment (Pty.) Ltd. Mr Plumley has considerable overseas and South African experience in power and process instrumentation, and was convener with Mr N. Bleynhams (chief instrument engineer, USCO) of the meeting which resulted in the formation of the Instrument Control Society of South Africa (ICSSA) some two years ago.

Mr George Beebee has been appointed comptroller of the British Divisions of Yale and Towne Manufacturing Co.

The Admiralty has announced that **Capt S. E. Post,** O.B.E., M.I.E.E., is to be promoted to Rear-Admiral from July 7 and to be chief staff officer (technical), Portsmouth, in succession to Rear-Admiral N. E. H. Clarke, to take effect in July, and to be Command Electrical Officer, Portsmouth, in continuation.

The Eastern Electricity Board have appointed **Mr G. W. Ruck,** F.C.A., as accountant of their Suffolk sub-area headquarters, in place of **Mr A. H. Lewis** who has recently moved to the board's headquarters at Wherstead. The board have also promoted **Mr L. Bradley** to succeed **Mr A. Walmsley,** A.A.C.C.A., who is retiring from the position of accountant to the Chilterns sub-area (*ESH, pages 106/111). Mr Bradley has been principal assistant in Mr Walmsley's department.

OBITUARY

Mr J. Bowen, a director of the North of England Engineering and Electrical Co. Ltd., has died, aged 65.

Mr J. C. Groocock, formerly a director of Sulzer Bros. (London) Ltd., died on 7 April, aged 73.

NEW LITERATURE

Nomographic Methods for the Calculation of Complicated and Strongly Saturated Magnetic Circuits of Electrical Machines.

by Prof Otto Benedikt

THIS book, written in German and containing 288 pages and numerous illustrations is a detailed and specialised work of particular interest to designers of d.c. machines, although the methods used hold equally for other types of electrical machines and apparatus. Considerable attention is devoted to the calculation of magnetic induction in armature teeth of various shapes, as well as the influence of the form of air gap and the shape and degree of saturation of the pole shoe projection, under light-load and load conditions. The text is detailed and over 100 numerical examples are worked out to illustrate the methods employed by the author. Three computing charts are provided to facilitate the calculations having field strengths up to 4,500 A/cm and induction densities up to 30,000 gauss; c.g.s. units are employed throughout.

The main aim of the book is to determine for all points along the rotor circumference, the e.m.f's induced by the various fluxes, the distribution of electric potentials, the electro-magnetic forces, the different types of losses and the electro-magnetic energy.

The utility of the book would have been improved if a list of symbols giving their precise meaning and the page number where they first appeared had been included. In addition an alphabetical index to the subject matter placed, as is usual, at the back of the book would have been helpful for the reader. Published by the Hungarian Academy of Science, Akademiai Kiado, Budapest V, Alkotmany, U.21.

New ideas on office lighting

CHANGE TO THREE-POINT SYSTEM ADVOCATED

AS was noted three weeks ago in the ELECTRICAL TIMES, the passage through Parliament of Mr Marsh's Bill on improving office conditions has focused considerable attention on office lighting. The latest assessment of this subject comes from Mr L. H. Hubble, F.I.E.S., in a paper presented on Tuesday to a joint meeting of the Association of Supervising Electrical Engineers and the Illuminating Engineering Society. Offices, in his context, referred to rooms in which some branch of administrative or clerical work is carried on and therefore excludes drawing offices.

The objective is to create lighting which (to borrow terms from the Factory Acts) is both adequate and suitable, with the inescapable corollary that this aim should be achieved by the most expedient and economical methods available. Adequacy is the simplest factor to determine. Most recommendations suggest a minimum level of illumination of 20 lm/sq ft which is sufficient where the visual task is no more arduous than reading fairly small dark lettering on white paper. Few offices, however, are so limited in their visual tasks that higher levels are not called for; most independent specifications, such as are prepared by consulting engineers, stipulate between 25 and 35 lm/sq ft.

Lighting Suitability

Suitability of the lighting may be regarded as ability to produce comfortable seeing conditions. The two main inhibitors of comfort are glare and undesirable shadows. The degree of discomfort caused by glare is as much the result of the area of the bright surface causing the glare as its luminance, and area is becoming increasingly important as luminous ceilings grow in popularity. Another source of large-area glare is the sky when seen through large windows, this situation being closely related to the provision of artificial lighting to supplement daylight.

In fact, the trend is to conceive lighting as a single function, in contrast to the present, generally held premise that artificial lighting is an alternative to natural lighting. This single-function concept of lighting should be incorporated in the interpretation of suitability in some practical form, capable of ready understanding, which can be applied equally to the relighting of all types of existing offices as well as to new premises.

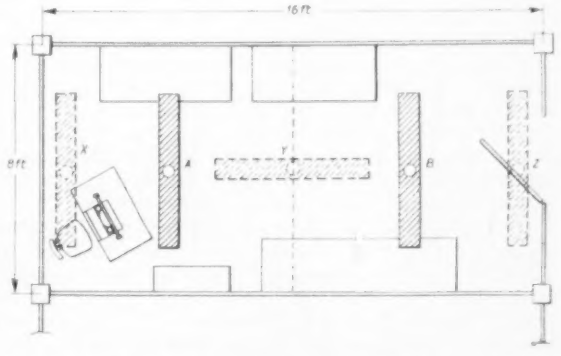
The single-function concept may be translated into practical terms first by considering the unsuitability of present practice. A typical arrangement is shown in plan in the diagram. It portrays an office, 16 ft by 8 ft, arranged for a secretary/typist, and, in common with most office areas, occupying one window bay. The usual two lighting points provided are those fittings marked A and B; ignore for the moment fittings X, Y, Z. The ceiling is 10½ ft, which is about 7½ ft above the working plane. The spacing-height ratio is about 1:1; unit area 8 ft sq at, say, 20 lm/sq ft. A diffuser fitting is employed giving a coefficient of utilisation of about 0·3. This indicates a lamp averaging an output of 4,350 lm for each unit area.

Since the greater part of the typist's working life will be in daylight, she will sit with her back either directly or obliquely to the window. There will be a door to the corridor, leaving the two side walls either wholly or in part for filing cabinets and perhaps a spare table. Hence, with fitting A sited either directly above or slightly behind the typewriter, the illumination provided on the vertical paper surface in the machine is virtually nil; it is provided only by light reflected from the ceiling between the typewriter and the window.

The fitting B is across the typist's field of view when she looks up and is sufficiently large and bright to cause considerable discomfort glare, particularly as her eyes are normally adjusted to the lower luminance of the paper on which she is typing. The fitting B is also badly orientated to the filing cabinets; being end on, it presents a projected area so small as to be obscured by anyone using the cabinets.

The first step to correct this situation would be rotate fitting B through 90°, so that it lay parallel to the major axis of the room, thus presenting the maximum projected area normal to the filing cabinets and the minimum to the typist. The second step would be move fitting A nearer to the window, so that it lay between the window and the typewriter, with a corresponding shift of fitting B to the centre of the room. Both fittings might also be modified to direct the greatest amount of light where it was wanted and still further reduce glare.

The two fittings thus rearranged represent, in fact, fittings X and Y as shown. It will be realised, however, that the general movement of these fittings towards the window will have reduced the level at the corridor end of the room to below its acceptable value. A third lighting point (fitting Z) must therefore be added, giving a basic three-point design instead of the present two-point system. Apart from its improvement to the artificial lighting, the



Typical 16 ft by 8 ft office area occupying one window bay, and arranged for use by typist or secretary. Fittings A and B represent present two-point lighting system; X, Y, Z indicate preferred arrangement giving improved seeing conditions

three-point system also facilitates the practical implementation of the single-function concept, since it readily lends itself to providing permanent artificial light to supplement daylight.

Supplementary lighting, not merely to achieve a prescribed illumination standard but also to offset the effect of sky glare, requires the artificial lighting to establish an illumination gradient, whose level extends from near zero at the window to a value near the corridor some two or three times that required after dark. If this requirement is imposed on the three-point arrangement, it will be seen that not only will the distributions from the three fittings be different, but that fitting Z will have two separate functions. During the day, it will need to operate as a multi-lamp fitting to provide the necessarily greater amount of artificial light required farthest from the window. After dark, it will need to operate merely as a single-lamp fitting, to give the required uniformity in the lower level of illumination provided artificially.

The first task is, therefore, to devise a formula, or set of tables based on a sectional element (which may be very small or of some finite dimension), from which the required gradient of the supplementary artificial lighting can be determined, thus allowing the amount and distribution of the flux to be calculated. As soon as some gradient data have been established, it will be possible to design appropriate lighting fittings.

Contribution to heating

When considering economy, the single-function concept of lighting also alters established thinking. Until recently, the economics of office lighting could reasonably be limited to a direct comparison of capital and running costs of different systems, as still largely applies in industrial premises. With some artificial lighting provided throughout the day, and with the generally higher lighting levels now in use, the heating effect of the lighting assumes significant proportions and the lighting installation may not now be divorced from the building heat control. It has been shown that 30 lm/sq ft of tungsten lighting is almost equivalent to the average dissipation of a floor-warming installation. Broadly, the artificial lighting load could be drawn from the heating budget, except, of course, during the summer. The fact that useful heat is being dissipated in the lighting also means that careful attention to ventilation is required to avoid its waste.

Various suggestions are made for changing older office accommodation into the three-point system. In many purpose-built office buildings (as opposed to converted houses), it will be possible to introduce a suspended ceiling which conveniently provides means to redesign the lighting and also hide the wiring. Post-war office blocks, although improved in some respects, are still little different in terms of lighting from their predecessors of 30 years ago, particularly in the purely speculative blocks, where few landlords have thought it necessary to provide lighting as part of the building's amenities. This attitude is surprising in that it would be thought easier to let office space which included a good standard of day-cum-artificial lighting rather than one which did not.

Perhaps the most useful contribution to post-war office building has been the widespread application of the modular concept. Its principal effect has been to replace the grid system of wiring points with regular lighting areas integrated into the basic design, which together with fenestration leads readily to total lighting. Another term now in vogue for office lighting is flexibility, although this may be regarded as an admission of reluctance to provided good total lighting at the outset. However, the idea of flexibility has not merely stimulated the use of acoustic tile ceilings integrated with the building module; it has also introduced the flush trunking which serves to support the tiles and lighting fittings and to enclose wiring. Such trunking, however, is most satisfactorily utilised in transverse runs, from windows to corridor, these being related to the natural subdivision of the office area provided by the window mullions. Runs of trunking would then be installed along the window centre line and along the line of the mullions, the former giving outlets for the three-lighting points, the latter used as a register for partitioning. The transverse runs could be linked with some form of lengthwise runs of main trunking over the windows and/or in the corridor area.

Luminous ceilings may be considered as an approach towards the concept of total lighting, but the currently held belief that these ceilings should be uniformly flashed creates a dull, depressing atmosphere. If it is desired to suggest the variations of natural lighting, a thin ceiling membrane is to be desired, with a transmission factor between 0·75 and 0·9, so that the location of the lamps gives areas of higher luminance.

Uganda plans second hydro scheme

THE potentialities of electricity supply in Africa are well illustrated by the annual report of the Uganda Electricity Board which shows that, as the Owen Falls station nears completion, electricity supplied has risen during the year by 25% to 315 million units.

The Owen Falls station now has eight sets in operation, bringing the rating to 120 MW of the ultimate installed capacity of 150 MW. Estimated cost of the completed station is £16½ million, or equivalent to £110 per kW. This figure compares favourably with other recent hydro-electric schemes. Preliminary designs were prepared during the year for a further 180 MW hydro-station at Bujagali, 4½ miles downstream from Owen Falls. Discussions with Kenya are also going ahead for future development of hydro-power in East Africa. Civil work at the 0·75 MW Kikagati station increased the effective head to 19½ ft making available an additional 460 kW of generating capacity.

The board found it necessary to increase tariffs as foreshadowed in last year's report, to meet the heavy burden of interest charges, averaging 4½% on money borrowed. Although operating for only two-thirds of the year, the new charges, coupled with the connection of 3,700 new consumers, resulted in a revenue increase of £275,000, bringing revenue for the year to just under £1,670,000.

The number of new consumers connected, as noted above was 3,700, bringing the total in the country to nearly 28,000. The board is conducting a vigorous campaign to increase consumers, especially in the areas served by the new supply networks associated with the Owen Falls scheme. A simple consumer unit has been designed by the board for their lower income customers, consisting of a switch, socket and lamp bracket mounted on a wooden panel.

The board is also giving particular attention to increasing electrification in cotton ginneries and coffee factories which form an important feature of Uganda's predominantly agricultural economy.

Nearly 400 miles of 33 and 11 kV transmission lines were added to the system during the year with relatively small increase in the number of maintenance staff.

PROBLEMS AND PRACTICE

We welcome contributions to this feature; those published will be paid for at our standard rates. There must be many problems encountered in day-to-day electrical work, or useful ideas or tools devised to make it easier; all make instructive reading.

On Record

I WAS interested to read of J.H.R's experience "Costly Cooking" (31 Mar. issue) and to note that he keeps a record of the resistances of electric cooker hot plates. When I was engaged on that type of work, we did not seem to find time, during the hustle and bustle of general contracting, for that sort of thing. However, at a large chemical works where I am now concerned with the maintenance system, we have adopted a similar scheme of keeping a record of the resistance of the various industrial heaters installed there.

These heaters are of the oil-immersed type and it is a substantial undertaking to get at the elements to check them when complaints are received that they are not getting warm enough, or some such trouble. With the resistance data at our disposal, we find that we can usually get an idea of the condition of the element and this enables us to trace the fault more quickly than in the past.

At another works, I once recommended a system of keeping the record of the resistance of the windings of electrical rotating machinery where this was possible. Not all electrical staffs are equipped with an instrument which reads down to a few ohms, nor have they got the time, but this particular place had an electrician who had not got a great deal to keep him occupied when everything was running sweetly, although his existence was justified when breakdowns occurred.

We had noticed that not every insulation breakdown of electric motors was accompanied by the well-known burnt-out odour. Moreover, a surprisingly large proportion of breakdowns, when tested with a "Megger" insulation resistance tester gave a satisfactory reading to earth, sometimes as high as 20 megohms. We also found a number of burnt-out three-phase motors which, when tested with an ohmeter, gave a balanced reading for each of the phase windings. In short, we would be presented with a burnt-out motor which did not smell, had an insulation resistance of 20 megohms to earth, and had windings of the same resistance in each phase, this resistance being about the right value as far as we could judge.

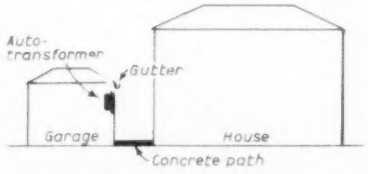
Given these conditions, we often experienced delay in rectifying the fault as no electrician likes to take a motor to pieces unless he is sure there is something wrong with it. In order to help the electrician to "make up his mind," we started keeping records of the resistances of the phase windings of the machines, both cold and hot, and we found it saved time in diagnosing the fault.

It was necessary, however, to emphasise to the people concerned in making these records (including the typist) that it was absolutely essential to be accurate and to keep them up to date. Only in this way was it possible to establish faith in the records, and thus avoid possible acrimony when they were being used in tracing a particularly difficult case.—*"Surveyor."*

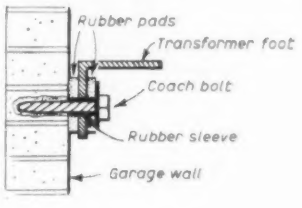
Hum Trouble

LIVING in a town of mixed voltages presents many problems, one of which arose recently. Although it was solved without much difficulty, it still left its true cause undetermined.

A newly built house in a 200 V area which will eventually become uprated to 240 V, had an auto-transformer fitted to save the necessity of changing elements and re-winding the motors when the voltage change took place. When the owners of the house moved in, they complained of a loud humming noise occurring during the night. The auto-transformer which was not particularly noisy, was mounted on the garage wall, but as this was separated from the house by a 3 ft wide concrete path, it did not seem possible that the transformer could be the cause. There were no connecting pipes between the house and the garage, the cables, all twin p.v.c., being routed through a short glazed duct. The only closely associated metal was a length of cast iron guttering fixed along the side of the garage.



Above shows relation of house to garage containing auto-transformer; below is detail of rubber mounting to minimise hum transmission



The position of the occupant's bed in the house was against the outside wall on the garage side and it was feasible that if the auto-transformer did get noisy during the night (although it is difficult to reason why) it might transmit its vibration to the house, and there did not appear to be any other explanation for the noise. As it was probable that any noise that was transmitted would be by vibration, it was decided to provide the auto-transformer with rubber mountings. This was done by fitting a rubber pad on either side of the transformer feet and a rubber sleeve on the bolt spindle.

This has cured the noise problem although it still leaves a few doubts as to the true cause, and short of carrying out extensive tests and spending a few nights on the site, it is difficult to arrive at a positive conclusion. Perhaps other readers may have more definite views on the subject.—*W. Satchwill.*

A Plate-full of Shocks

RECENTLY, I was called to one of the paper mills, for whose electrical installations I am responsible, to investigate motor control gear on which the metal case was reported to be alive, the operator having received several shocks. Suspecting lack of continuity in the conduit as the cause of the shocks (and wondering why the fuses had not blown) I connected a voltmeter between the case and a reliable earth. No voltage was indicated and it was assumed that the fault was intermittent.

Leaving the instrument connected, I prepared to examine the starter, the first step being to open the isolating switch. As soon as I touched the switch handle, I received a shock, although the voltmeter was still indicating zero. The lack of potential seemed to show that it might be the wood floor (which was damp), rather than the starter case, which was alive.

Investigation revealed a metal patch which had been nailed to the floor in the corner, but was buried under a pile of wet jute. This metal was at 240 V to earth. Examination in the room below showed that nails about 3 in. long had been driven right through the floor, and into one core of a t.r.s. cable on the underside. The cable was prised clear and repaired, the nails were bent over and the floor patcher suitably lectured on his hamfistedness.—*J.A.*

for the electrical trade

Translucent light panels

TRANSLUCENT formed plastic panels with rear lighting make effective display items. The Finish Automation Co. Ltd. have produced a large range of formings for use as ceiling lighting units as well as point of sale display. One example is a detailed reproduction of a Greek head, decorated in classical fashion and formed with white p.v.c. This head is available at £2 2s 6d minimum. *Finish Automation Co. Ltd., Andover Gdns, N.7.*

New chime, old price

THE "Big Ben" door chime has been redesigned, but its old price of 16s 3d still stands. This chime is contained in a slim white horizontally ribbed case which should merge with any decorative scheme. Its chime bars, improved for higher quality sound, give a two-note signal. "Big Ben" Mk III, 7 in. tall by 4½ in. wide, is only one of a large range of Friedland chimes covering a wide variety of designs and sound signals. *V. and E. Friedland Ltd., Macclesfield, Cheshire.*

Battery vacuum sweeper

A BATTERY-OPERATED version of the "Blue Bird" vacuum sweeper is now on the market. "Exide" batteries provide power for drawing loose dust into a special bag, whilst two independent sets of rotary brushes driven from the wheels sweep the bulk of litter into a front container. Two 12 volt 48 Ah batteries are employed. They can be recharged through a fitted plug and need not be removed from the machine during the process. *Cimex-Fraser Tuson Ltd., Cray Ave, Orpington, Kent.*

The "Blue Bird" sweeps and vacuum cleans on two 12 V batteries

Three-heat infra-red fire

A NEW infra-red fire employs three silicon elements, each with a separate reflector and individual switch. The elements each carry a load of 500 W and can be switched on in unison, in pairs or singly according to the warmth required. The fire is contemporary in style, with a gold finish expanded metal grid. Dimensions 25 in. high by 24 in. wide. Price £9 17s 2d, including p.t. *Electrix Ltd., Dagenham, Essex.*

Vertical section tube fittings

A NEW range of fluorescent tube fittings, "Vistalite," has plastic rectangular section diffusers as its basic feature. These diffusers, measuring 4 in. square, are capped at each end with coloured metal boxes housing the control gear. One unorthodox model is a 2 ft 20 watt unit suspended vertically from a square metal "flare" base, coloured to match the lower cap. This slightly concave flare provides a balancing background to the vertical tube. The fitting may, if desired, be installed monolithically on a table. More conservative tastes are provided for by the normal 4 ft horizontal fitting, a 40 watt model which can be supplied with an attractive pierced metal surround as an alternative to the plastic diffuser. *Courtney, Pope (Electrical) Ltd., Amhurst Pk Wks, Tottenham, N.15.*

TRADE PUBLICATIONS

ROCOL.—20-page illustrated booklet on molybdenum disulphide lubrication from Rocol Ltd., Rocol Hse, Swillington, Leeds.

ATLAS.—Guide to projector or photographic lamps from Atlas Lighting Ltd., Thorn Hse, Upper St. Martin's La, W.C.2.

G.W.B.—Leaflets on control gear and Lectrodryer moisture absorber unit from G. W. B. Furnaces Ltd., Dudley, Worcs.

E.E.—Leaflet on prices of moulded relay cases by English Electric Co. Ltd., Stafford.

N. AND Z.—16-page brochure R30/2E on automatic controllers. A/19 leaflet describing Type IR integrating indicator. Negretti and Zambra Ltd., 122 Regent St, W.1.

GORDON.—Illustrated catalogue of temperature measuring instruments. James Gordon and Co. Ltd., Stanmore, Middx.

WEDGLOK.—Pamphlet on self-locking screw from Guest Keen and Nettlefolds (Midlands) Ltd., Box 24, Heath St. Birmingham 18.

IONIC.—Pamphlet describing metal plating processes from Ionic Plating Co. Ltd., Grove St, Birmingham 18.

WINCH.—Descriptive brochure on Ward-Leonard winch for a.c. or d.c. from Clarke, Chapman and Co., Gateshead 8.

ERMA.—Leaflet on solderless terminals, cable lugs, crimping tools and equipment from Erma Ltd., Alperton, Middx.

Atlas distribute Forrest

FROM now on, all fittings manufactured by George Forrest and Son are to be distributed by Atlas Lighting. The "Modern" ranges of glass and metal fittings, therefore, now take normal Atlas rebate and discount terms. Both firms are subsidiaries of the Thorn Electrical Industries Group.

Portable sterilisers

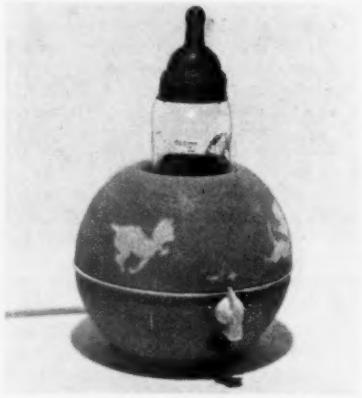
GEC have introduced a range of four portable steam surgical sterilisers incorporating thermostatic control, an advantage usually found only in heavier duty units. In these models the thermostat operates in a vapour tube, maintaining temperature at boiling point using only 15% of full current load. This system ensures that there is no excess of steam to damage surrounding materials, and allows the operator freedom to leave the instrument unattended for long intervals. A lever action opening mechanism simultaneously raises the instrument tray and lifts the lid, locking them in the open position. Boiling times of the four models range 28 min to 40 min, loadings from 1½ kW to 4 kW. *General Electric Co. Ltd., Kingsway, W.C.2.*

New mushroom lamps

ATLAS announce a new range of small mushroom-shaped lamps. It consists of three "Silverlight" models, all lamps having sleeved fuse leads and moulded neck seal. Loadings 60, 100 and 150 W; prices 1s 8½d, 1s 11½d and 2s 10½d respectively. *Atlas Lighting Ltd., 109 Judd St, W.C.1.*

Baby bottle warmer

BABY'S milk can be raised to a comfortable temperature within four minutes and maintained there by the "Bonnibabe" bottle warmer. This device is an aluminium globe container with an opening in the top to accommodate normal sized feeders in a standing position. A simple turning switch with + and − indicators controls the thermostat, allowing the bottle to be kept warm for overnight feeding. 80/120 W a.c., fully suppressed. Price £2 17s 6d, including p.t. *Bonnibabe Products Ltd., 16 Philpot La, E.C.3.*



"Bonnibabe" keeps feed tepid for hours, £2 17s. 6d.

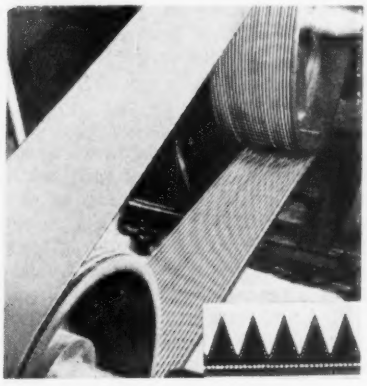
equipment for industry

Insulation flash tester

FLASH testers with either 2 or 4 kV ranges have recently been supplemented by additional models incorporating a 500 V d.c. supply for insulation testing. Changeover from the a.c. h.t. flash testing supply to d.c. for insulation testing is effected by a switch mounted on the instrument test prods, a feature which is expected to save time in test departments. The flash testers include a voltmeter connect to the h.t. test prods. A circuit breaker tripping in half a cycle with less than 5 mA h.t., is claimed to render the instrument non-lethal. The a.c. testers may include an in-phase leakage indicator for checking leakage resistance while a flash test is in progress. Continuously variable output voltage in the h.t. range is obtained from a 250-step double-wound transformer. *Clare Instrument Co., Ashacre La, Worthing, Sussex.*

Multi V-belt gives higher power

A SUBTLE combination of the V-belt design with a flat belt enables power transmitted per inch width of belt to be increased by as much as 50%. The "Poly-V" belt has this feature. It consists of a flat belt with parallel V-grooves moulded on to its inner surface. These grooves mate with similar ridges on the drive pulleys and so give not only greater contact area than a simple flat belt, but also provide a lighter and more flexible drive than a flat belt or individual V-belts. The belts are particularly suitable for high-speed ratio, short centre drives and can be used with pulley diameters of only ¾ in. They can be applied to a wide range of applications from washing machines to machine tools. The belts are made from synthetic rubber compound having heat- and oil-resistant properties. Strength is imparted to the belt by high tenacity synthetic cords treated to secure a good bond to the belt material. The base rubber is softer than is normally used for belt construction. This permits it to act somewhat like a hydraulic fluid and to fill the pulley grooves, thereby exerting an even pressure over the belt face and ensuring even wear. The rib faces are either cloth or compound covered. A machine tool application giving an example of the belt's capabilities has a Poly-V drive transmitting 10½ h.p. per inch width at 4,000 r.p.m. on a 4 in. diameter pulley. *Turner Bros. Asbestos, Rochdale, Lancs.*



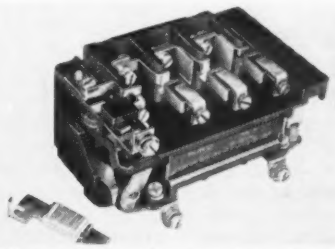
The "Poly-V" belt has a grooved inner surface which mates with grooved pulleys giving higher output with less slip for a given width than the conventional flat belt

Oxide film resistors

THE Electrosil range of resistors now includes a 2 W rated unit at 70°C. This unit, the C42, is only ¾ in. long and ⅝ in. diameter. The resistance may be from 100 ohm to 1·4 megohm with a tolerance of ±5%. Price reductions are also announced of 25% in the Electrosil type P resistors. *James A. Jobling Ltd., Wear Glass Wks, Sunderland, Co. Durham.*

Motor protection

RECENT modifications to a well-known range of thermal overload and single-phase preventors permits these units to be quickly and simply modified for a different current rating. In the original version, operation of the trip mechanism depends on deflection of bimetal strips associated with each phase conductor, but the new version uses a detachable heater element which can be changed to meet altered current requirements without interfering with the trip-setting mechanism. Each element is identified by a code letter and is intended for use within ±10% of its rating. Tripping is adjustable to values of 100, 125 and 150% of this rating. The mechanism will trip if current in one phase is interrupted with slightly less than full load current in the other two phases. The unit is shock-proof, fully temperature compensated and make and break are positive. The thermal elements have an inherent time lag which varies with the degree of overload. *Electrical Apparatus Co. Ltd., St. Albans.*



A feature of the combined overload and single-phase preventor introduced recently by EAC is the detachable heater unit permitting rapid change of operational range

Sealed miniature relay

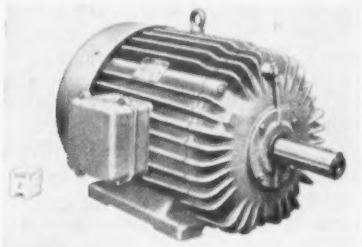
A RELAY requiring only 0·35 W to operate its d.p. changeover contacts has recently been announced. The contacts are of gold-plated silver and are suitable for a 2 A resistive current at either 28 V d.c. or 110 V a.c. The relay is sealed in a nitrogen-filled container and has a rotary balanced armature construction, said to give good performance even under severe vibration. The relay can be used in ambient temperatures from −65°C to 100°C and measures 0·78 in. by 0·35 in. by 1·03 in. over the terminal pins. *Magnetic Devices Ltd., Newmarket, Suffolk.*

Hermetically sealed plugs

TWO new products have been introduced by Electro Methods. The first is a hermetically sealed plug with provision for from five to nine contacts for solder connections. The contacts are supported in a glass plate which is itself fused into a ½ in. diameter metal soldering ring. A transistor plug and socket has also been introduced which shrouds the transistor and provides a convenient means of plugging-in without risk of damage during resoldering. *Electro Methods Ltd., Caxton Way, Stevenage, Herts.*

Motor range increased

RECENTLY, the AEI motor and control gear division introduced their KN-D range of squirrel-cage induction motors complying with BS 2613 and having class E insulation suitable for a temperature rise of 65°C. This range has now been increased from 7½ to



AEI's range of KN-D motors with class E insulation has recently been extended from 7½ to 40 h.p.

40 h.p. at 1,500 r.p.m. These motors are t.e.f.c. machines complying with the dimensions of draft BS A(ELE) 1629. They are available from stock and are also interchangeable with the type KN-C drip-proof motors built in accordance with BS 2960. *AEI Ltd., Motor and Control Gear Division, Rugby.*

Porvic for export

PORVIC, the microporous p.v.c. plastic used as plate separators in the lead acid batteries made by Pritchett and Gold can now be supplied for export. Porvic is said to be inert and virtually indestructible. Its high porosity ensures low internal cell resistance and its strength permits inter-plate clearances to be kept small. *Pritchett and Gold and EPS Co. Ltd., Dagenite Wks, Dagenham Dock, Essex.*

Cable markers

LABELLING ferrules attached to cables in complicated wiring circuits can save an immense amount of time during fault finding, but they can also be a source of annoyance if they can turn on the cable and thus become unreadable. This snag is said to be successfully overcome in a specially shaped ferrule, recently introduced, which grips the cable firmly and yet can be applied without using special tools. Numbered and lettered markers are available in ten colours, suitable for cable sheath diameters from 0·1 in. to 0·5 in. *Critchley Bros. Ltd., Brimscombe, Stroud, Glos.*

Snap-on security

THE use of saddles for securing rubber or p.v.c. insulated cables to walls or enclosures of electrical plant is a practice which has advantages particularly where damp conditions or excessive condensation makes enclosure within tube or conduit undesirable. The relatively soft nature of the cable insulation, however, necessitates the use of cleats or clips on non-conducting material preferably of a design which will grip without deforming the cable sheath. A recent entrant into this field is the "Snapway" range of cable saddles which comprise a single-screw fixing base, the outer edges of which are serrated to accept and retain an inverted U-piece, correspondingly serrated on the inner faces, both being of translucent plastic material. With the cable in place, the U-piece is pressed on with just sufficient force to grip the insulation without damaging it. There are two sizes and prices range from 12s 6d to 16s 8d per 100 for the small, and from 13s 4d to 17s 6d for the large, according to quantities and subject to the usual discounts. *Metway Electrical Industries Ltd., Canning St, Brighton 7.*

D.C., from a.c. welding units

A "PLUG-IN" rectifier unit, suitable for connection to the output of most a.c. welding machines, enables them to be used for processes requiring d.c. up to 250 A for welding. The unit consists of silicon rectifiers mounted in a sheet metal case with skids for ease of movement. Welding current is controlled from the a.c. machine. The unit has been introduced for those applications, such as non-ferrous argon arc welding, where a d.c. supply is essential. The unit is weatherproof and the rectifiers are naturally cooled. *Quasi-Arc Ltd., 213 Oxford St, Bilston, Staffs.*

Flameproof level controllers

THE "Lectralevel" floatless liquid level controllers have now been approved for operation under hazardous gas conditions. Suitable units are available for both flameproof and intrinsically safe requirements. *Londex Ltd., 207 Anerley Rd, S.E.20.*

Supply decade in Malaya

TEN years ago the Central Electricity Board of the Federation of Malaya was inaugurated and the tenth annual report shows how much progress in electricity supply has been achieved in the subsequent period.

There are, today, three times the number of consumers that existed when the board was formed and the number of units sold has increased 4½ times, despite heavy restrictions which have been imposed on the board's main consumer, the tin mining industry. Even so, the industry consumed 43% of the electricity sent out for supply.

Decline in tin mining accounts partially for the decrease in sales of 2·3%, although increased tariffs resulted in a slight overall revenue increase of 2·4%. Total units generated in the Federation was 933 million and the average price charged rose to 8¼d per unit.

Generation

The board operates 39 stations with an aggregate installed capacity of 159 MW. Most of these are diesel stations, and only five of them showed an operating surplus on the year. A further 190 MW of plant, again largely diesel-driven, is operated by licensed public supply authorities in 178 stations distributed throughout the Federation. In an attempt to effect economies in generation, the board have placed orders for two 3 MW free-piston gasifyer turbo-alternators which will be installed at Butterworth. Sets of this type are thought to be particularly suitable in the range 3 to 10 MW. They may also be used at Johore Bahru, which is at present supplied from Singapore. Expansion of such a station by steam sets to an ultimate 60 MW is contemplated. The 20 MW first section of the 40 MW Malacca oil-fired steam station was commissioned in April and was followed in June by the 0·9 MW hydro station at Robinson Falls. This station will eventually be linked to the Cameron Highlands project which has a planned capacity of 105 MW, and will be the largest single station in the Federation.

German companies have been awarded the main civil engineering contracts for the Cameron scheme and a French company are providing mechanical and electrical plant for the main underground power station at Jor. A detailed investigation of the Cameron Highlands project second stage is now under way. This stage, known as the Batang Padang project, will have an output of 100 MW and, on the basis of present load growth, it is estimated that construction should begin in about 1970.

The board are increasingly appointing Malayans and, during the year, the number in senior posts reached 39% of such appointments. After this year, the process is expected to speed up with the return of students. There are, at present, 36 students studying overseas.

Fatal accidents fell during the year to five and many of the accidents reported were due to mishandling of domestic appliances.

The board licences local installations for electricity supply and, in an attempt to improve standards, the board called in chargemen (who advise managers of such installations) during the year to check their knowledge of the electricity regulations and their ability to carry out supervision work and make reports. It was found that, in most cases, they were unsuitable and managements of installations have been advised to engage supervising electrical engineers instead. (The board carries out examinations for certificates of competency as electrical engineers—two grades—chargemen wiremen and wiremen.)

News of the Week

APPLIANCE LEGISLATION IMMINENT?

Molony Committee submit interim report to B.o.T.

THE likelihood of the Government introducing general legislation next session to provide for safety standards in various domestic apparatus is heightened by the interim report of the Molony Committee on Consumer Protection, recently submitted to the President of the Board of Trade.

Apart from the drip-feed oil heaters, it is understood that the report suggests quick action concerning the safety standards of many other consumer goods, including some types of electrical apparatus. Earlier this week, it was not known at the Board of Trade whether this interim report would be published.

Meanwhile, the Molony Committee are still considering the material submitted by various organisations for inclusion in their full report to the President of the BoT.

The committee, under the chairmanship of Mr J. T. Molony, Q.C., was appointed last year by the Government to collect and examine evidence concerning the quality, performance and safety of consumer goods with a view to making suitable recommendations for legislation, designed to protect the interests of the consumer.

Dounreay reactor to close for tests

THE first series of experiments with the fast-breeder reactor at Dounreay (Caithness) will be completed this week. The reactor will then be shut down for about three months while changes are made in the "core" of the reactor so that a wider variety of types of fuel can be tested. As an experimental tool, the Dounreay reactor has been designed so that minor and major components may be easily replaced when different designs have to be tested.

The reactor started operation at low power on 14 Nov., 1959. Since then, an intensive programme of physics and engineering research has been carried out, designed to provide information for the operation of this experimental reactor at higher power levels, and to help in the design of a fast breeder reactor prototype.

Tuscan Engineering Acquired

ALL the Ordinary share capital of Tuscan Engineering Co., manufacturers of special electric motors, has been acquired for £115,000 cash by Beck and Co. (Meters) Ltd., a subsidiary of Hattersley (Ormskirk) Ltd., engineers and brassfounders. Mr G. I. Payne continues as managing director of Tuscan.

Powell Duffryn Bid for Hurseal

AN offer made by Powell Duffryn Ltd. for the share capital of Hurseal Ltd., consisting of 160,000 Ordinary shares of £1 each at a price of 47s 6d per share, has been accepted.

Hurseal and its wholly-owned subsidiary, Gulf Radiators Ltd., make a wide range of domestic and industrial central heating equipment. Their acquisition is a further step in the development of Powell Duffryn's existing interests in the marketing of heating and air conditioning equipment through Janitor Boilers Ltd. and Powell Duffryn Modulair Ltd., sole UK licensees for Dravo industrial space heaters and Tuttle and Bailey air distribution equipment.

Mr A. C. Hazel continues as managing director of the reconstructed board of Hurseal. Mr Miles Reid (a director of Powell Duffryn) becomes chairman in place of Mr R. S. Bassett, who retires. Mr O. Keir and Mr B. W. Wade also retire. Others joining the board are Mr H. W. Sharland (deputy chairman, Powell Duffryn) and Mr R. Turner (managing director, Powell Duffryn Technical Services), while Mr H. Hollesen and Mr B. L. B. Hutchings continue as directors.

Cookers and 'fridges sales gain

ELECTRIC cookers and refrigerators both showed appreciable gains in February compared with the previous month in appliance sales figures for area boards in England and Wales issued last week. Compared with the same month last year, refrigerator sales in February were more than 50% up. Washing machines declined slightly, however, from the static level of the three months preceding, and were also down on February, 1959. The demand for water heaters continued to show an increase.

Type of Appliance	Sales in month ended		Sales in 12 months ended	
	29 Feb. 1960	% change over Feb. 1959	29 Feb. 1960	% change over previous year
Cookers ...	27,334	+13.4	341,605	+ 23.0
Water Heaters:				
Immersion	8,980	+ 9.5	191,193	+ 15.2
Storage ...	5,438	+22.5	61,934	+ 20.2
Washboilers	4,930	− 5.8	65,725	− 17.2
Washing machines ...	11,969	− 7.1	159,888	+ 31.5
Refrigerators	5,335	+51.1	167,767	+110.4

When assessing the figures shown in the table above, it should be borne in mind that area board sales represent only a part of total appliance sales throughout the country.

DorDec Report

Sales of British-made domestic refrigerators in Feb. totalled 85,994 on the home market, compared with 37,728 in the same month last year, according to the latest DorDec figures. There was also a small increase in exports.

Wage Claim Deadlock

NEGOTIATIONS on a pay claim for manual workers in the electricity supply industry ended in deadlock at last week's meeting of both sides. It now seems that if no easing of the position is reached, the employers' side may, at a meeting called for 19 May, propose that the matter be sent to arbitration. Meanwhile, representatives of the five unions involved are to meet again on 20 April to consider the matter.

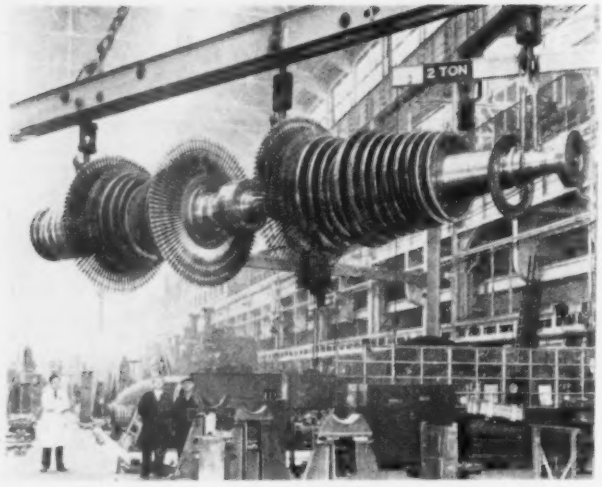
Earlier threats of an unofficial three-day strike have been deferred "until it is more opportune and favourable" the unofficial leaders announced last Saturday.

Following last week's meeting, Mr C. T. Melling explained that the employers' side had offered a general pay review after 30 June, by which time they should be able to judge the effect of the recent reduction in the working week. Such a review could be completed in three months and any increases negotiated could apply early in September, but the unions had insisted an immediate substantial increase in pay.

New Remington Subsidiary

THE activities of the Electric Shaver Division of Remington have been taken over by a new subsidiary company, Remington Electric Shaver Ltd., responsible (from 1 April) for the manufacture and marketing of Remington electric shavers and shaving products.

Mr John J. Collins becomes chairman and managing director of the new company and will also control production at the Remington factory near Glasgow.



Picture (taken at AEI's Manchester works) shows the steam turbine rotor for one of the four 150 MW turbo-generating sets for the Burrard power station of the British Columbia Electric Co. The turbines, of the three - cylinder close-coupled reheat type designed for initial steam conditions of 1,800 lb/sq in., 1,000°F with reheat to 1,000°F, will run at 3,600 r.p.m.

Tomorrow's Electric Greenhouse?

ONE of the highlights of the international flower show to be held in Ghent, Belgium, from 23 April to 2 May, will be an automatic greenhouse—a prototype of the "Greenhouse of Tomorrow" equipped with a large number of electrical devices designed to provide the perfect plant environment.

In the one house, three separate climates and two seasons are provided under fully automatic control. This is achieved by means of thermostatically controlled air warming, bench and soil warming, and automatic ventilation in the main house (which is run at moderate temperature). An enclosed propagating case, equipped with separate space heating and bench warming, provides a separate and higher temperature climate.

Automatic shading is effected by running a semi-opaque liquid over the glass of the greenhouse from a perforated copper pipe—a technique devised by ERA Field Station and still the subject of further research.

The automatic greenhouse is being shown by BEAMA in co-operation with the British Committee for Overseas Flower Shows, and most of the electrical equipment will be supplied by BEAMA member firms.

Six and Seven: next step

AT a meeting of the Trade Committee of 20 governments held in Paris on 29 and 30 March, representatives of the European Free Trade Association took the initiative in putting forward a proposal for avoiding discrimination for 18 months, namely, to extend to the Common Market Six the tariff cuts they are due to make on 1 July, if the Six are prepared to act on a reciprocal basis. The reactions of the Six to the proposal are expected to be revealed at the next Trade Committee meeting in May.

On 1 July, the Seven are due to make their first tariff cut of 20%, while the Six will make their second reduction of 10%, or, if the Rome Treaty is accelerated, an increased cut of 20%, plus a raising of external tariffs.

£700,000 order for Plessey

A £700,000 contract to supply aircraft generation systems for Vickers' latest jet airliner, the VC10, has been received by Plessey. The first 35 of these aircraft have been ordered by BOAC and delivery will start in 1963.

This contract follows a new licensing agreement between Plessey and the Westinghouse Corporation, USA, which allows Plessey to produce and market throughout the world (except US territories and Canada) Westinghouse aircraft electrical generation systems.

Tube Stock Renewals

PLANS to speed up the replacement of rolling stock on London's Central and Piccadilly Underground lines are announced by London Transport. In addition to the 532 cars of aluminium alloy 1959 Tube stock at present under construction, LT are to order several hundred further cars.

Servis pass the million

TO celebrate "Passing the Million" in the production of Servis washing machines, the manufacturers, Wilkins and Mitchell, are launching an extensive promotion campaign on 21 April. A double-page spread in the *Daily Mail* and *Daily Express*, claimed to be the biggest domestic appliance advertisement ever, will start a long-term advertising campaign to continue throughout the year, embracing commercial television and the national and provincial Press.

A special display pack containing a window pelmet, showcards and other promotional material in the colours of gold, red and black is available to Servis dealers to enable them to tie in with the company's intensive publicity campaign.

H.P. active in Feb.

THERE was a further strengthening of hire-purchase business in February, with an active demand for domestic appliances, radio and other electrical goods. The total h.p. rose to £889 million, compared with £873 million in January, and £596 million in February, 1959. Of this, the amount owed directly to household goods shops in February, 1960, was £334 million, an increase of £4 million on the January figure.

During February, sales of electrical and radio goods by independent retailers rose 8% on January, reaching an index of 111 (1957=100), but department stores showed a gain of 22% in sales of electrical and radio products.

£½ million Blyth "B" contract

THE superstructure for the main and ancillary buildings and for the turbo alternator blocks at the new Blyth "B" power station, Northumberland, is to be built by the Mitchell Construction Co., Peterborough, under a contract placed by the CEGB. Value of the order is £½ million, and work will begin in June next.

OFFICIAL PUBLICATIONS

BS 3224. High-Intensity Elevated Runway-Lighting Fittings. 4s.

BS 3227. Vulcanised Butyl Rubber Compounds. 3s.

BS 3232. Specification for Safety Requirements for Medical Treatment Lamps. 5s.

BS 1568. Magnetic Tape Sound Recording and Reproduction. 4s 6d.

ERA Reports:

D/T106. Intrinsically safe Electrical Apparatus. Relation of Igniting Current to Inductance for Ethylene Air Mixtures, E. R. Wooding and F. Shaw (6s); D/T110. Spontaneous Ignition Temperatures of Inflammable Gases and Vapours. A Critical Resumé. H. G. Riddlestone (10s 6d); G/T319. Switching Transients Measured on the Live 132 kV System. Comparison with Network Analyser Results. J. S. Vosper (15s); L/T379. Resistance of Sheet Insulation to Surface Discharges. J. H. Mason (15s); O/T23. Protection of 11 kV and 33 kV Line Insulators from Damage by Power Arcs. A. E. Guile and S. F. Mehta (12s); Z/T118. Joints in Aluminium and Aluminium Alloy Busbars. Experiments on Contact Resistance. A. P. Singh (12s 6d).

Toxic Substances in Factory Atmospheres. HMSO. 1s (see page 623).

Crane makers unite for exports

THREE manufacturers of cranes who last year amalgamated have now reorganised their overseas marketing organisation with a view to increasing exports against the threat of intense foreign competition in world markets.

Steels Engineering Products Ltd., R. H. Neal and Co. Ltd., and F. Taylor and Sons (Manchester) Ltd. have combined forces for selling abroad, dividing the world into three major zones and creating a separate marketing organisation for each. The British Crane Co. Ltd., with headquarters in London, will organise marketing throughout the Sterling area, four of the Outer Seven countries, Africa and Asia, operating in three divisions, each covering a separate geographical zone.

The International Crane and Excavator Corporation of New York will promote sales in the western hemisphere and certain other dollar areas, and a European sales company based in Switzerland will be responsible for marketing in Common Market countries and Austria and Switzerland.

New Prestcold HQ

THE London region of the Prestcold Division of the Pressed Steel Co. Ltd., has now been centralised in new headquarters at 409 Halifax Rd, Greenford, Middx, where 100,000 sq ft of floor space are available. The new premises have absorbed the administrative offices formerly in Sceptre Hse, Regent St, and the service centre in Chiswick, and also house stocks of refrigerators and commercial refrigeration equipment previously stored at the Hammersmith warehouse. Sceptre Hse remains as a West End showroom and demonstration centre.

In charge of the new headquarters is Mr M. S. Ware, Prestcold's general manager, London region. Mr J. Parker is deputy general manager, Mr E. C. Thomson is service and supplies manager and Mr H. W. J. Bartholomew is commercial sales manager.

The headquarters contains a new 2,000 sq ft display room for refrigerators and has a radio control room for the company's fleet of service vehicles, all of which are equipped with two-way radiotelephone.

STEEL PRICE CHANGES

MAXIMUM prices of certain steel products were revised last Monday, involving both increases and decreases which, while correcting the overall price structure, have no appreciable effect on the general level of steel prices. The products concerned are stainless and alloy steels, cold rolled carbon steel strip and certain specifications of non-alloy bright steel bars and heavy rails. A sample change shows an increase for stainless steel black bars of £13 a ton, and a decrease for stainless steel plates and cold rolled strip of £9 and £13, respectively.

Dealing with Toxic Atmosphere

MEASURES for the protection of workers against the inhalation of dusts or fumes or other impurities likely to be injurious are discussed in a new booklet, *Toxic Substances in Factory Atmospheres*, published by the Ministry of Labour last Friday. This is the latest in a series of booklets designed to give information and advice about questions of safety, health and welfare in industry.

The booklet gives figures of maximum permissible concentrations of certain substances used in industry as a guide to which the efficiency of various control measures should be related. The figures are subject to revision in the light of increasing scientific knowledge.

Amendments to the list will be published from time to time, and arrangements have been made to send them, on request, to those who return a postcard contained in the booklet indicating their desire to receive the amendments. The booklet is available from HMSO, price 1s.

Health and Safety in Welding

A SPECIAL course for nurses on Health and Safety in Welding, arranged by the School of Welding Technology in conjunction with the Royal College of Nursing, is to be held on 21 May, at the Institute of Welding, 54 Princes Gate, S.W.7.

The course, which lasts from 9.30 a.m. to 5.15 p.m., consists of six lectures covering various aspects of welding hazards from clinical and legal viewpoints. The fee, £4 for members of IoW and £6 for non-members, includes lunch, tea and refreshments.

The spring meeting of the institute, to be held this year at Droitwich from 9 to 11 May, is to be devoted primarily to some of the more recently developed processes such as fine wire welding, electroslag welding and high frequency welding, and one session will be concerned with varied uses of metal spraying. The programme also includes a series of works visits.

Cooker Q and A

QUESTIONS and answers on electric cookers, listing their advantages and points of usage, are contained in a new leaflet entitled *Modern Electric Cookers*, published by the Modern Cooking Promotional Committee, supplies of which are available in bulk, free of charge, from C. S. Services Ltd., 5 Carlos Pl, W.1.

SERVICING STREET LAMPS

Specially designed to cope with any overhead street lighting operation, this Harbilt electric truck fitted with an Access "Tallescope" provides a compact, versatile service vehicle for general overhead work, and is particularly useful for local authorities. The Tallescope gives a working height of 28ft when mounted on the truck and has adjustable legs to compensate for road camber and gradients. Truck range is 20-30 miles. The vehicle is the result of the combined efforts of Access Equipment Ltd. and Harborough Construction Co. Ltd.

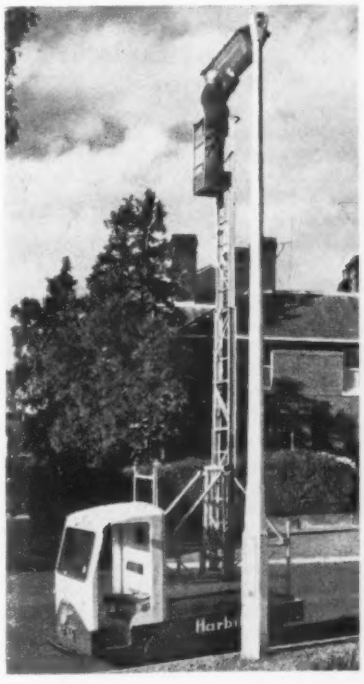
£1m power scheme in the North-east

AT a meeting of the Consultative Council of the NEEB last week, it was reported that the board had approved further estimates amounting to £1,059,757, covering 116 housing schemes and 76 rural electricity supply schemes. In December, January and February, the board commissioned 233 new substations, the majority for rural supplies, and h.v. supplies had been connected to 14 industrial and commercial consumers.

NEEB have completed negotiations for supplying another 141 agricultural premises and 140 more miles of cables and mains have been brought into use.

1959 BRAY LECTURE

THE 1959 George Bray Memorial Lecture on the Packaging of Engineering Products is to be presented by C. H. Bulmer of the Printing, Packaging and Allied Trades Research Association to the Institution of Production Engineers on 1 June next. The venue is the Grand Council Chamber of the Federation of British Industries, 21 Tothill St, S.W.1, and the lecture, which begins at 6.30 p.m., will be followed by a discussion. Admission by ticket available on application to the secretary of IPE, 10 Chesterfield St, W.1.



Orders for Electric Mine Winders

MINE winders with a total value of nearly £475,000 are to be supplied by the Heavy Plant Division of AEI to collieries in South Wales, Scotland and Yorkshire. At Bedwas Colliery, in the Coal Board's S.W. Division, two double-drum winders, one of 2,600 h.p., the other of 2,400 h.p., will be installed. The d.c. motors will be supplied by mercury-arc rectifiers.

The Scottish order is for two tower-mounted multi-rope a.c. friction winders for a new shaft at Cardowan Colliery, near Glasgow. The winders will be driven through epicyclic gears by 1,050 h.p. 750 r.p.m. motors.

The third order is for a 2,100 h.p. winder at Lofthouse Colliery, near Wakefield. The existing winder drum will be used, and the 2,100 h.p. 407 r.p.m. motor will be coupled by means of reduction gears and a solid coupling.

The electrical equipment for Cardowan Colliery will be manufactured at Rugby, as will the rectifiers for Bedwas. The motors and control gear for Bedwas and Lofthouse will be made at Trafford Pk, Manchester.

Power down the Mine

GREATER use of electricity in place of compressed air for mining coal in Cumberland is planned by the Northern (Northumberland and Cumberland) Divisional Coal Board. In this way it is hoped to increase the efficiency of the small Cumberland coalfield which has operated at a loss for many years.

Reassuring miners who were opposed to the change on the grounds that compressed air is safer, Mr J. Lomax, manager of the coalfield, pointed out that it was not electricity that was dangerous, but firedamp in the air, and great efforts were being made to reduce firedamp in working sites.

"Compressed air- and steam-driven machines belong to a past decade, and power through wires is the modern way," he added.

ERIC serves L.C.C.

LONDON County Council's electronic computer, known as ERIC (Electronic Recording and Integrating Computer), was officially inaugurated at a ceremony performed by the chairman of the Council, Mr S. J. Barton, at the County Hall last Tuesday. Said to be the most comprehensive installation of its kind in local government service in Britain, the computer will be used for accounting, clerical and statistical work.

ERIC is on hire from IBM (UK) Ltd. at an annual charge of some £60,000.

Report on radiation hazards

THE report of the interdepartmental committee that has been considering possible hazards to health from intense radio-frequency radiation has now been received by the Postmaster-General. The committee recommends safety precautions to be taken at radio transmitting stations and other establishments where such radiation (which is similar to that sometimes used for industrial and medical heating) is generated. The recommendations are to be put on sale soon by HMSO.

Tufnol in the making

STAGES in the formation of Tufnol resin-bonded paper sheets and rods are depicted in a 16 mm colour film which has a running time of about 20 minutes. Step-by-step the film follows the manufacturing process from the paper and synthetic resin raw materials to the finished article. The film was shown for the first time at a reception held at the Mayfair Hotel, London, last week. Copies are available from Tufnol Ltd.

Solartron and John Brown form joint company

JOHN BROWN AND CO. LTD. and Solartron Electronic Group Ltd. have formed a joint company, Solartron-John Brown Automation Ltd., to exploit the Gumpertz Automatic Warehousing system, which provides a method of selecting hundreds of different stocked lines for dispatch in a matter of minutes.

In place of the conventional bins the warehouse is fitted with rows of steeply slanting shelves, each rising to a height of many feet and carrying a single line of packets, tins or jars. At the bottom of these shelves is a barrier which, when electronically actuated, releases one or more packages onto a belt travelling under the whole bank. The whole order is diverted onto a main belt which delivers it to the packing department.

The system will, say the promoters, revolutionise warehousing and the supermarket. The firm have exploitation rights for all countries outside USA.

Electrical Quiz for Housewives

EDA's Electrical Quiz Competition held among the National Union of Townswomen's Guilds to promote interest and know-how in domestic electricity supplies and appliances is proving a remarkably effective education for thousands of housewives. A small textbook, *All About Electricity*, specially produced by EDA as a basis for study, has been read and absorbed by all those taking part in the quizzes. The booklet is divided into three parts: (i) Supply of electricity and wiring of premises; (ii) Electrical service in the home; and (iii) Some background information about local boards.

On 5 April the London finalists, the Wimbledon team, demonstrated their prowess by answering questions put to them in a mock quiz organised by EDA at the Building Centre. The four team members were asked such questions as "What are the two methods of wiring a house, and which do you consider the best?" and "Describe the two types of refrigerator." The team answered fully every question put to them.

Finals will be held in the Royal Albert Hall on 25 May, with Sir Edwin Herbert presiding and John Snagge as compère. Franklin Engelmann is to act as question master.

Aerial view of one of the first ten AEI electric locomotives for British Railways under construction at the Gorton Works of Beyer Peacock Ltd. In the mid-length can be seen the main transformer in its tank, with the smoothing choke in the foreground. A further 25 locomotives to be supplied by AEI are being built at Smethwick

Westminster Electric "Horses"

A NEW electric vehicle for refuse collection is being tested by the Public Cleansing and Transport Dept. of Westminster City. It consists of a "mechanical horse" and trailer, powered by a 44-cell 405 Ah Kathanode traction battery manufactured by the DP Battery Co. Ltd., and can cover 14 miles in a working day. As most refuse collection is done at night or in the early morning, electric vehicles offer the big advantage of quiet operation.

If the tests are satisfactory, the new vehicles may replace the existing Westminster electric horses, some of which have been in use for more than 20 years.

STANDSTILL BUDGET?

COMMENTING on the Budget, Sir Leslie Gamage, chairman of the General Electric Co. Ltd., said: "We expected a standstill Budget and we have got it. The Chancellor has kept the way open to the expansion of heavy industry by not changing the investment allowance. This is an important consideration in industrial re-equipment.

"On the other hand, raising Profits tax by one-quarter means that additional funds—which could have been earmarked for industrial investment—will now go in taxation.

"I hope that restrictions on private credit, which the Chancellor mentioned as a possibility, will not be thought necessary in view of the record level of savings last year. The British consumer is entitled to rising living standards."

Linear Accelerator for Weld Inspection

A LINEAR accelerator having an energy rating of 4·3 MeV is the subject of a development contract placed by the UKAEA with Mullard Equipment Ltd. The machine will be used for weld examination and will be capable of producing a high definition radiograph of a 6 in. thick steel specimen in 100 seconds. The accelerator's high energy rating will permit radiographs to be obtained more quickly than with conventional X-ray and isotope sources and will also enable greater thicknesses of material to be penetrated. It will have an output of over 600 Rontgens per min in air at a 1 metre focus film distance. The accelerator is intended for use on site during construction of nuclear power stations and will have power supply and control equipment mounted in a separate transportable cabin.

Sayings OF THE WEEK

"The fact that we apply a realistic and forthright formula for retail pricing should not be too readily accepted as undercutting our competitors." . . . MR C. F. RICHARDS, managing director, Morphy-Richards, writing to the *Financial Times*.

"The problem of making so large a building as a power station harmonise with the countryside in which it lies is a new one to the landscape architect and, in approaching so new and large a problem, mistakes must be expected." . . . SIR CHRISTOPHER HINTON, addressing the County Councils' Association planning committee.

"It is thanks to science that the average housewife has more servants than the Duchess of Devonshire had in the eighteenth century." . . . PROF W. H. G. ARMITAGE, of Sheffield University.

PRICES of cable metals and other materials

Figures quoted are the official prices ruling on Monday, April 11

	£ per ton	Weekly change £
COPPER, standard class A (settlement) ...	259	+5
" (3 months)	241½	+¾
LEAD, refined pig, 99·97% purity (cash)	77½	−¼
" (3 months)	76¾	−¼
TIN, refined, min. 99·75% purity (settlement)	788½	−2
(3 months)	786	−¾
ALUMINIUM, ingots 99-99·5% ...	186	—
wire bars (4×4×54")	209	—
BRASS Strip 63/37	221¾	+3
SILVER (Troy oz)	79d	—

	£ per ton	Weekly change £
ZINC, virgin, min. 98% purity (cash)	92½	+¾
" (3 months)...	89½	+¼
RUBBER, per lb.		
No. 1, R.S.S. spot	34½d	+1d
c.i.f. basis, ports, June	34½d	+½d
ARMOURING:		
Galv. Steel Wire (0·104 in.) ...	66½	—
Mild Steel Tape (0·04 × 1½ in.)	53*	—
NICKEL (home)	600	—
MERCURY (76 lb flask)	70½	—
AMERICAN PRICES:		
Copper, electrolytic (per lb) ...	33c	—
Lead (New York)	12c	—

* *Tape Price, now an average, includes varnishing*

Grease gun accident claim fails

A CLAIM for damages by an electrician, who was injured in an accident with a grease gun while employed by the Yorkshire Electricity Board, was dismissed by Mr Justice Slade at Leeds Assizes last week, when giving judgment with costs for the defendants, the YEB.

Mr G. G. Priestley, aged 35, electrician and part-time musician, of Halifax, said that on 4 July, 1957, at the board's service station in Highroad Well, Halifax, he had to move a high pressure grease gun in order to put a pair of pliers on to a tool rack. He picked up the gun without deliberately pulling the trigger and suffered injury to the index finger of the left hand, which later had to be amputated.

In cross-examination it was suggested that Mr Priestley's story was untrue. The judge commented: "There was ample ground for that suggestion. He must have forgotten all about a statement he made in his own handwriting to his employers only a day after the accident when he said he was taking an interest in the grease gun and pressed the trigger.

"I have no shadow of doubt that this story about a pair of pliers is completely untrue. He pressed the trigger of the grease gun, not, of course, knowing what the pressure was."

Sizewell 275 kV Route

THE West Suffolk Planning Committee has urged the CEGB to route the new 275 kV line from Sizewell nuclear power station through West Suffolk alongside the 132 kV line already running over about 10 mile of the countryside. The County Planning Officer has explained that the board wanted the shortest route because of the cost involved, but their proposed route would cut across some of the best countryside in the east of England. Herts, Essex and Cambridgeshire shared the view that duplication was the best solution.

Scottish Contractors meet

THE Electrical Contractors' Association of Scotland will hold their annual conference from 20 to 22 May next at the Glenburn Hydro, Rothesay.

Record Meter Engineers' Dinner

WITH a record attendance of 189, the Meter Engineers' Technical Group of the EPEA held their twelfth annual dinner in the familiar surroundings of the Palmerston Restaurant last Friday. The vice-chairman, A. A. Yardley, A.M.C.T., A.M.I.E.E., proposed "Our Guests" and paid particular welcome to those who had presented papers during the year, and one such, H. J. Lovegrove, responded.

The toast to the chairman was proposed by A. M. F. Palmer, A.M.I.E.E., who paid tribute to the chairman's record of service in the industry. In reply, A. T. Bailey, A.M.I.E.E., thanked the committee and officers for their support. The evening was concluded by entertainment from Charlie Preby and Bob Andrews.

News in Brief

Blyth "A" power station is to be officially opened on 29 June by Mr J. C. Mitchell, former controller of the North Eastern Division, CEGB.

Durham RDC is to borrow a further £10,000 for the provision of electric cookers in new houses.

Carville power station, Wallsend-on-Tyne, built about 60 years ago, has been closed down.

Stephenson Clarke Ltd. have been appointed the sole agents to the South of Scotland Electricity Board for the commercial development and sales of fly ash outputs at Braehead, Portobello, Kincardine and Barony power stations.

Douglas Corporation (IoM) have received approval to borrow £18,500 for extensions. Of this, £4,000 is for transformers and switchgear, £8,000 for mains and services, £1,500 for meters and £5,000 for kettles.

Company Activities

WHILE the Budget brought a great deal of reassurance on the underlying soundness of the economy, it also confirmed the widely discussed doubts for the country's immediate future. More than once I have pointed out that the Chancellor's chief concern is to accelerate the Nation's exports and to avoid anything in the nature of a balance of payments crisis. But at the same time he has to juggle with differing rates of expansion at home from: (1) light manufacturing industry supplying consumer demand; and (2) from heavy industry equipping lighter industry. There is a labryinth of interplay and significance between all these claims on Britain's resources of materials and manpower. It is the Chancellor's task to guide and to manipulate all these economic processes to the greatest advantage of the greatest number.

This year he had to encourage exports, encourage heavy industry, but, at the same time, to moderate consumer demand which could now easily assume inflationary proportions, but not to curb to any extent that it would cause a cut-back in the expansion plans of the heavy capital industries. That is why it was such a pot-shot and piecemeal Budget. 2d on cigarettes! Nothing much to discourage spending on cars and refrigerators there.

But it was what the Chancellor said —not what he did—that is now making for a resurgence of uncertainty in stock markets. Mr Amory's ". . . the time may soon arrive when it would be right that we should take steps to restrain further expansion of private credit: and we stand ready to do so." Coupled with the latest reports that the big banks are now exercising a stricter control on new lending are creating a psychology of caution which may obviate the need later on to introduce actual physical strictures on the public's spending.

My list of leading electrical companies (tabulated below) shows how this particular market has responded to the Budget. Confidence was mounting above Friday's closing levels for the Ordinary shares on the Monday before the Budget announcements. At the end of dealings on the Tuesday, the day after the Budget, interest was substantially maintained. But by the end of the week, with the notable exceptions of Vactric and Holland's Philips Lamps, fears for the shorter term future had become the dominating influence.

	Friday 1 April		*Monday 4 April*		*Tuesday 5 April*		*Friday 8 April*	
	s	*d*	*s*	*d*	*s*	*d*	*s*	*d*
AEI	54	7½	54	10½	54	1½	52	9
BICC	58	6	59	6	59	6	57	9
A. C. Cossor	7	10½	7	10½	7	10½	7	9
Decca	52	4½	53	0	52	10½	53	1½
EMI	55	3	55	9	55	0	51	0
English Elec.	42	1½	43	4½	42	10½	41	3
GEC	39	9	41	0	41	0	40	0
Morphy-Richards	19	10½	20	4½	20	10½	19	7½
Philips	168	6	169	3	174	3	175	9
Vactric	36	10½	37	9	37	10½	38	6

My advice to the genuine investor remains the same as before. Good shares will outride these market fluctuations. Electrical shares bought today will handsomely repay investors over the longer term.—*From our City Correspondent.*

R. and A. G. Crossland

The dividend is being raised on the existing £100,000 capital from 32½% to 37½% for 1959, and it is proposed to make a one-for-two scrip issue. Before taxation, the group profit is £95,983 (*£94,389*).

Enfield Rolling Mills

Consolidated trading profit for 1959 jumped to £2,161,186 from the 1958 figure of £1,806,324. A distribution of 15% is maintained with a final dividend of 12½% on capital increased by the acquisition of Enfield Cables Ltd. After taxation and other charges, net profit is £892,432 (*£737,725*).

Murphy Radio Ltd.

Group profit for 1959 reached the record total of £668,085, compared with £451,400 for the previous year. After larger taxation charge, net profit is £358,442 (*£207,724*). Dividend is raised 2½% to 22½%.

Pressed Steel Co.

After taxation charge of £2,367,579 (*£2,342,779*), net profit for 1959 increased to £2,461,506 (*£2,017,598*). Distribution is also raised 5% to 30% with a final dividend of 21%.

Rheostatic Co. Ltd.

Net profit for the year ended 30 Sept. last increased by 64% to £178,157—the result of an expansion of the company's business in all its markets and practically all areas of operation. The one difficult spot is Canada, where the subsidiary is to concentrate on a smaller number of profitable lines, but Mr M. J. Gartside, the chairman, warns that eventually it may be expedient to close down that subsidiary completely. Even so, export business continues to represent a very substantial proposition of the company's turnover, while at home, the realisation of the advantages of engineered heating systems, and the increased sale of consumer durables such as cookers, washing machines and water heaters, in which Satchwell controls are involved, has provided good business. Provided there is no intensified credit squeeze, he is optimistic of results for the current year. The proposed one-for-three scrip issue we noted on 31 March.

Switchgear and Cowans

The current year opened with a satisfactory order book and the chairman, Mr J. L. Rowbotham, confidently anticipates full output in all sections throughout the year. Pilot production of the new range of medium and h.v. switchgear has started. Mr Rowbotham also points out that the new factory has to be equipped this year and put on a production basis. A considerable amount of plant, he adds, will have to be transferred from the No. 2 factory without unduly disturbing production. These changes mean a busy and difficult year and while no spectacular advance is expected in 1960, the results should at least equal if not exceed those for 1959.

Ultra Electric (Holdings)

It is proposed to raise approximately £1 million to finance further expansion, involving a rights issue. The offer is of 990,500 new Ordinary 5s shares on a one-for-three basis, at 19s each. A further 38,000 new Ordinary will be offered to employees (excluding directors) at the same price. The directors state that the group turnover for the year ended 26 March last increased by about 50% over the previous year and it is expected that profits, before tax, will show a similar increase.

Watford Electric and Mfg. Co.

To mark the diamond jubilee of the foundation of the business, a one-for-one scrip issue of 546,875 Ordinary 2s shares is proposed, but the directors point out that the issue will not necessarily lead to an increased distribution of profits. It is proposed to increase the capital to £350,000 by the creation of one million Ordinary shares, but there is no immediate intention of issuing the extra shares. Mr J. L. Lawson, chairman, reports that the value of orders received during 1959 showed a considerable increase over the preceding year, and with reasonable optimism it is hoped to obtain a satisfactory share of the larger volume of business now available.

Year to 31 Dec.	£ Trading Profit	£ Net Profit	% on Ord.		Ord. Price	
			Earned	Paid	High	Low
1955	101,098	46,149	47	25	9/-	6/6
1956	113,507	47,804	44	25	7/7	5/5
1957	154,201	70,281	64	25	6/10	5/7
1958	187,658	89,496	66	25*	8/2	4/-
1959	140,727	73,092	53	25	15/3	7/5

*Plus 25% capital bonus.

Dividends Declared

British Relay Wireless and Television. Second interim of 5%.

Strand Electric Holdings. Interim 7% (6%).

COMMERCIAL INFORMATION

Contracts Open at Home . . .

Dates given are the final for receipt of tenders unless otherwise stated.

14 April—Birmingham C.C. Supply of 2,500 c.i. Class "B" columns; combined lanterns and brackets; 4,000 synchronous time switches; 500 "Keep Left" bollards for year from 1 May.—See 7 April issue.

14 April—West Riding C.C. Rewiring of Boston Spa Primary School and Stainforth Junction Rd Primary School.—See 7 April issue.

15 April—Cork. Supply of electrical canteen equipment at St. Finbarr's Hospital, for South Cork Board of Public Assistance. One each—tilting frypan, 20 gal stockpot, 10 gal stockpot steamer, hot cupboard, dishwasher and drier, food mixer and two fans.—See 24 March issue.

15 April—Dunfermline T.C. Separate trades contract electrical work in 80 four-storey maisonnettes, Aberdour Rd. Applications to Burgh Architect, 6 Abbot St, by above date.

15 April—Swansea B.C. Electrical installation in Clase E.S.N. School. Applications giving details of previous similar experience to Borough Architect, The Guildhall, by above date. Deposit £2.

16 April—Upholland U.D.C. Supply and erection of 256 60 W sodium lamps on 15 ft columns. Engineer and Surveyor, J. T. Iball, Municipal Bldgs, Upholland. Deposit £2 2s.

16 April—Wexford B.C. (1) Lighting installations in 22 houses, Fisher's Row.—See 7 April issue.

18 April—Cornwall C.C. (f) Provision of electrical services, on fixed-price basis, in Bodmin County Secondary School. Applications to County Architect, Truro, by above date.

18 April—Flint B.C. Supply and erection of 10 Class "A" 25 ft concrete columns and m.v. units on Prince of Wales Ave. Borough Engineer and Surveyor's Office, Earl St. Deposit £2 2s.

19 April—Wallasey T.C. Electrical installation in Egerton Grove School extensions and alterations.—Advertised 31 March issue.

20 April—Lanark C.C. Electrical work in erection of new R.C. primary school at Whitehill, Hamilton. Applications to County Clerk, Ian V. Paterson, 191 Ingram St, Glasgow C.1, by above date.

20 April—Londonderry. (3) Provision of electrical engineering services at Templemore Special Care Centre, Academy Rd, for N.I. Hospitals Authority. Applications to secretary, 27, Adelaide St, Belfast by above date.

20 April—Willesden B.C. (a) Supply of Group "A" sodium lanterns and ancillary equipment; (b) supply and erection of concrete columns, wiring and fixing. Borough Engineer and Surveyor, Dyne Rd, N.W.6. Deposit £2 2s.

21 April—Manchester C.C. Electrical installation in Moseley Rd Secondary School extensions. City Architect, P.O. Box 488.

22 April—Bromsgrove U.D.C. Supply and putting into service of 35 prestressed concrete columns, 25 ft mounting height, with totally enclosed 140 W sodium lanterns—alternatively 25—200 W sodium lanterns on 30 ft steel columns.—See 7 April issue.

22 April—Galway C.C. Supply and installation of duplicate 3-ph. motors, horizontal centrifugal pumps and chlorination unit for Ballymoe Water Supply Scheme.—See 3 March issue.

23 April—Bishop's Stortford U.D.C. Provision of tubular heating in Council Offices and underfloor heating, lighting and power installations in extension. Engineer and Surveyor.

23 April—Cardiff. Supply of h.v. laboratory equipment, including 300 kV testing transformer and 330 kV impulse generator for Welsh College of Advanced Technology.—See 7 April issue.

25 April—Abertillery U.D.C. Supply and erection of (a) stage lighting equipment at Metropole Theatre. Engineer and Surveyor, R. H. Eke, Abertillery, Mon.

25 April—East Riding C.C. Supply and erection of 13 cut-off sodium lanterns, etc., of 25ft steel fluted columns at A64 Spital roundabout.—See 7 April issue.

25 April—Manchester C.C. Supply and installation of passenger lift at Newall View Aged Persons' Home, Wythenshawe. City Architect, P.O. Box 488.

25 April—Newmarket R.D.C. Supply and erection of vertical spindle sewage pumps in two stations for Burwell, contract includes motors, control gear, valves, piping and other ancillary gear.—See 7 April issue.

26 April—Bangor B.C. Provision of 62 single-arm concrete columns with three 80 W fluorescent units. Town Clerk, Town Hall, The Castle, Bangor, Down, N.I.

26 April—Belfast. (c) Electrical installation in new voluntary primary school at Clady Corner.—See 7 April issue.

27 April—Blackpool C.B. Supply of (a) Group "A" post-top fluorescent lanterns including control gear; (b) special cast iron spigots for post-top fluorescent lanterns. Director of Lighting and Electrical Services, Rigby Rd East, Blackpool.—Advertised in this issue.

27 April—Ealing B.C. Contract A—supply of 105 3 x 80 W fluorescent lanterns/lamps and 46 400 W MBF/U lanterns, lamps and control gear. Contract B—supply and erection of 150 25 ft steel columns.—Advertised 7 April issue.

27 April—Sutton Coldfield B.C. Supply and erection of sodium vapour lamps/lanterns and 30 ft steel columns on A453, Tamworth Rd.—See 7 April issue.

27 April—West Riding C.C. Applications for inclusion in list of approved contractors for work value (1) £1,500 to £5,000; and (2) £5,000 to £10,000, to County Architect, Bishopgarth, Westfield Rd, Wakefield, by above date. Contractors to be on N.I.C.E.I.C. roll and to provide three architect/engineer references together with bank name/address.

28 April—Isle of Axholme R.D.C. Supply and erection duplicate centrifugal unchokeable sewage pumps each of 120 g.p.m. and one of 50 g.p.m. sludge pump.—See 7 April issue.

29 April—Helmsey R.D.C. Contract 2. Provision and erection of duplicate pumping plant each capable of handling 2,400 g.p.h. against a 330 ft head. Details from consulting engineers, Arnold Brooksbank and Son, 48 Sunbridge Rd, Bradford 1. Deposit £5 5s payable to R.D.C.

29 April—Kilwinning T.C. Supply of 73 140 W lanterns for A78 lighting.—See 7 April issue.

29 April—Stourbridge B.C. Provision and installation of 441 Class "B" street lighting units. Borough Engineer and Surveyor, H. W. Morris. Deposit £2 2s.

30 April—Dumbarton T.C. Applications for separate trade schedules for erection of 130 houses Leven/Clyde streets and 40 houses Townend Rd to J. D. Smith, Town Clerk, by above date.

30 April—Glantawe Hospital. Applications for inclusion in prescribed lists of contractors for (B) electrical supplies; (E7) electrical work, (E9) maintenance of refrigerators.—See 7 April issue.

2 May—Willenhall U.D.C. Provision and fixing of Group "B" 80 W mercury discharge lighting and erection only of Stanton 9A concrete columns.—See 7 April issue.

3 May—Enniskillen. Electrical installation, by registered contractors, in new voluntary school for boys, Derrin Rd.—See 31 March issue.

4 May—Bingley U.D.C. Supply (except columns) and erection of 113 Class "B" lighting units on various roads. Engineer and Surveyor, Town Hall, Bingley. Deposit £2 2s.

4 May—Cardiff C.C. Supply of (1) concrete lighting columns; (2) lanterns, lamps and control gear; (3) solar time switches for year to 31 March, 1961. City Surveyor, City Hall, Cardiff.

4 May—Castle Ward R.D.C. Provision and erection 43 200 W linear sodium units on 35 ft steel columns on A1, North Gosforth. Engineer and Surveyor, G. E. Dimmock, Council Offices, Ponteland, Newcastle upon Tyne. Deposit £2 2s.

4 May—Wandsworth T.C. Supply and erection of 2,600 steel and concrete columns plus ancillary gear for sodium discharge lighting.—Advertised 7 April issue.

Your Queries Answered

Readers are invited to make use of our free enquiry department which possesses wide resources, including an index of trade information with over 100,000 entries

A Selection from the 104 queries answered this week

"The Duchess" potato peeler—makers of? E.E.W.—Monsyd Kitchenware Ltd., 77 Gresham St, E.C.2.

"Winrod" aerials—makers of? L.E.C.—Belling and Lee Ltd., Gt. Cambridge Rd, Enfield, Middx.

"Bellino" spin driers—suppliers of? Y.E.B.—Ideal Home Domestic Electric Centre, 416 Green St, E.13.

"Sona-Chrome" coffee percolators—makers of? W.W.L.—N. C. Joseph Ltd., The Aluminium Wks, Stratford upon Avon, Warwicks.

"Limitlite" fitting incorporating a low voltage transformer—makers of? W.W.—Limit Engineering Co. Ltd., 31 Windsor St, N.1.

"Solite" fluorescent desklamps—makers of? C.A.—Mountsun Ltd., 146 New Cavendish St, W.1.

"Vacrom" resistance wires—makers of? H.M.—Vactite Wire Co. Ltd., 24 Queen Anne's Gate, S.W.1.

"Hi-Craft" ballast units—address for? S.E.B.—Smart and Brown (Engrs.) Ltd., 8 Rose and Crown Yard, King St, S.W.1.

"Synchronome" clocks—makers of? T.E.—Synchronome Co. Ltd., Abbey Mnfg. Estate, Mount Pleasant, Alperton, Wembley.

5 May—Glasgow T.C. (2) Provision of a five-ton o/h crane for Davyhulme Sewage Works Extensions.—See 31 March issue.

6 May—Dagenham B.C. Lighting and power installations in 102 dwellings, Limbourne Ave, Chadwell Heath. Borough Engineer.

6 May—Glasgow T.C. Electrical installations in Bridgeton and Shettleston libraries. —See 7 April issue.

No date stated—Ashby-de-la-Zouch R.D.C. Supply and installation of fluorescent lighting fittings and ancillary works at Council Offices, South St.—See 24 March issue.

No date stated—Sidmouth U.D.C. Supply of cast-iron street lighting columns, 12½ ft high.—See 24 March issue.

No date stated—Stanway P.C. Provision of 19 140 W Group "A" sodium lanterns on 25 ft concrete columns along A.12. Council Clerk, H. C. Miller, 24 Villa Rd, Stanway, Colchester.—Advertised in this issue.

. . . and Overseas

*Details of items marked * may be obtained on application to the Board of Trade, Lacon Hse, Theobalds Rd, W.C.1, quoting reference.*

19 April—S. Africa. (A) 10 25 kVA and (B) 10 50 kVA 11,500/433/250 V 3 ph. transformers. Town Clerk, Pretoria City Council, Pretorius Sq. B.o.T. (ESB/8555/60).*

25 April—Greece. 10 750 MVA, 22 kV outdoor o.c.b.'s and three current transformers. Athens Piraeus Electricity Co. Ltd., 4 Korai St, Athens. B.o.T. (ESB/9706/60/ICA).*

28 April—Australia. Relay parts 168 items. Director, Stores and Contracts, Postmaster-General's Dept., Melbourne. B.o.T. (ESB/8556/60).*

28 April—Sudan. One 10,000 g.p.h. at a 25 ft head centrifugal pump for Sudan Railways, Khartoum Central Drainage. Sudan Government Purchasing Agent, 3/5 Cleveland Row, S.W.1. B.o.T. (ESB/8716/60).*

30 April—Burma. 7 tons 7/·144 aluminium conductor, six 500 kVA 11/·4 kV transformers, three 625 kVA 33/11 kV transformers, 50 time switches 250 V, 50 A, 50 time switches 25 A 400 V, relay testing sets and oil testing sets. Controller of Stores, E.S.B., 197/189 Lower Kemmendine Rd, Rangoon. B.o.T. (ESB/9464/60).*

2 May—India. 33 kV metering equipment. Executive Engineer, Power Division (E and M) Punjab State E.B., Patiala. B.o.T. (ESB/9448/60).*

8 May—Kuwait. Tender DK22/2/7-60. Transformers. Dept. of Electricity, Water and Gas. B.o.T. (ESB/9449/60).*

10 May—India. Tender inquiry A/04399/59/EE, 11 kV and l.t. switchgear for Madras Port Trust. Details from Deputy Chief Accounts Officer (Eng.), Chief Engineer's Office, Madras 1. Fee 7s 6d. Documents on view at Eng. Branch, India Store Dept., Bromyard Ave, W.3, reference S.4223/59/NSC/ENG.2.

12 May—India. Flameproof air-break D.o.L. starters. General Manager, Singareni Collieries Co. Ltd., Andhra Pradesh. B.o.T. (ESB/8574/60).*

19 May—Egypt. Electrical distribution equipment for Abuzaabal Workshops. Mechanical and Electrical Eng. Dept., Egyptian Railways, New Collective Bldg, Shoubra Bridge. B.o.T. (ESB/9226/60).*

19 May—India. Inquiry A/300/59EE h.t. and l.t. cables for 11 kV sub-stations changeover. Details, fee 7s 6d, from Deputy Chief Accounts Officer (Eng.), Chief Engineer's Office, Madras Port Trust, Madras 1. Engineering Branch, India Store Dept., Bromyard Ave, W.3, viewing reference S.4260/59/NSC/ENG.2.

20 May—Belgian Congo. Lead accumulators. Service des Approvisionnements du Ministere du Congo Belge et du Ruanda Urundi, Brussels. B.o.T. (ESB/9264/60).*

23 May—Formosa. Four sets 12-channel, and two sets 6-channel carrier telegraph terminals. Central Trust of China. B.o.T. (ESB/8218/60/ICA).*

30 May—Egypt. Two 200 kW diesel generators for Aswan Station. Mechanical and Electrical Eng. Dept., Egyptian Railways, New Collective Bldg, Shoubra Bridge. B.o.T. (ESB/9226/60).*

31 May—New Zealand. One 150 ton, four-motor o/h travelling crane. Secretary, Tenders Committee, N.Z. Electricity Dept., Wellington. B.o.T. (ESB/6851/60).*

TRADE NOTES

Change of Name and Address. The name of the Wipac Group's sales company—hitherto known as Wico-Pacy Sales Corporation Ltd.—has been changed to Wipac Group Sales Ltd. Activities have also been transferred from Bletchley to a new factory and offices in Buckingham.

Changes of Address. As from 15 April Electrical and Radio Wholesalers (North Devon) Ltd., will be operating from 34 Trinity St, Barnstaple. The telephone number remains Barnstaple 4303.

Pentechnique Ltd. have moved to Imperial La, Cheltenham, Glos. Telephone Cheltenham 3591.

The office of Samuel Gratrix Ltd. at 139/149 Fonthill Rd, Finsbury Pk, N.4, has been closed down, and communicatipns should be addressed to Quay St, Manchester 3.

Agency. Findlay, Durham and Brodie, 6 Bloomsbury Sq, W.C.1, are now representatives for a South African manufacturer of all types of l.t. and h.t. insulators and transformer bushings.

TRADE MARKS

This information is extracted from the Official Journal by permission of the Controller.

Canomatic. 797,398. Class 7. Can openers, knife sharpeners, etc. Pifco Ltd., Watling St, Manchester 4.

Impalco. 794,470. Class 9. Apparatus, etc. Imperial Aluminium Co. Ltd., Imperial Chemical Hse, Millbank, S.W.1.

Radiohm. 794,418. Class 9. Electronic apparatus, etc. East Grinstead Electronic Components Ltd., Imberhorne Industrial Estate, East Grinstead.

Robophone in design. 782,031. Class 9. Apparatus for incorporation in telephone receiving circuits for automatically recording messages by means of magnetic tape. Automation Telephones (London) Ltd., 10 Lyons Pl, N.W.8.

Ruton in design. 797,843/4/5/6/7 and 8. Class 8. Shaving instruments, etc. Class 9. Domestic machines, etc. Class 10. Heated blankets, etc. Electrische Apparaten-en Metaalwarenfabrieken Reidolf Blik, Televisiestraat hoek Rutonweg, The Hague, Netherlands.

Sleep-guard. B792,052. Class 9. Switches and automatic temperature responsive devices for controlling heated bed covers, etc. B792,053. Class 10. Heated bed covers. General Electric Co., 1 River Rd, Schenectady, New York, U.S.A.

Zeva. 796,268. Class 7. Machines and tools for sealing, welding and cutting polythene and cellophane film, etc. S. Kempner Ltd., 29 Paddington St, W.1.

Gazette Announcements

BANKRUPTCY ACTS

Appointment of Trustees

Stoke-on-Trent. R. G. Stevens, electrical retailer, carrying on business as R.S. (Sewing Machines) Co., and N. Midlands Electronic Co., at 66 Bucknall Old Rd, Hanley. Mr. P. J. Snow, 17 Albion St, Hanley, appointed trustee as from 28 March.

Salford. I. Fineberg and C. Wilson, retailers of electrical appliances, carrying on business in partnership as Modern Maid, at 28 Blackfriars St, Manchester 3. Mr J. A. Freeman, 8 Manchester Rd, Bury, Lancs, appointed trustee as from 25 March.

Cheltenham. W. G. Hampton, radio, television and electrical appliance dealer, carrying on business as W. G. Hampton and Son, at 115 St. Mary St, and 75 Church St, Southampton, 126/128 Prestbury Rd and Salem Hse, Clarence Parade, Cheltenham, 83 Cromwell Rd, 80 and 142 St. John St, Peterborough. Mr P. W. Hort, 28 Baldwin St, Bristol 1, appointed trustee as from 31 March.

Merthyr Tydfil. T. R. Thomas, electrical contractor, and E. Jones, television and radio engineer, carrying on business as T. R. Thomas and Co. at "Golden Key," Union St, Dowlais. Mr G. H. Down, 106 Walter Rd, Swansea, appointed trustee as from 31 March.

Release of Trustees

Birmingham. J. E. Woodcock, electrical contractor, carrying on business as Industrial Maintenance and Power Service, at 85 Pershore Rd South, King's Norton. Trustee: W. H. Haigh, 37 Temple St, Birmingham 2, released as from 25 March.

Brentford. W. R. Perkins, electrical contractor, carrying on business at 25 Villiers Ave, Twickenham. Trustee: W. Whitehead, 58/61 York Terr, N.W.1, released as from 24 March.

Ashton-under-Lyne. J. Darwen, electrical contractor, formerly carrying on business at Dane Bank Hse Wks, Windmill La, Denton, and 23 Reddish La, Gorton, Manchester. Trustee: J. Tye, 20 Byrom St, Manchester 3, released as from 31 March.

Receiving Order

Brighton. A. Lankester, building and electrical contractor, 65 St. Thomas's Rd, Worthing. Receiving order dated 31 March.

Intended Dividend

Birmingham. K. F. Haylor, manufacturer and designer of lighting fittings, formerly carrying on business as Lighting Developments at 70 Summer La, and at 67 Lyncroft Rd, Hall Green. Last day for receiving proofs for intended dividend: 16 April, to trustee: W. H. Haigh, 37 Temple St, Birmingham 2.

COMPANIES ACTS

S. and J. Appliances Ltd. Mr T. J. Newman, Bank Chmbrs, 214 Bishopsgate, E.C.2, appointed liquidator at extraordinary general meeting on 29 March for the purpose of winding-up.

H. Kaufmann Ltd. Mr F. T. Snow, Thames Hse, Queen St Pl, E.C.4, appointed liquidator as from 25 March.

Philip S. Schulman Ltd. Mr W. R. Johnson, 64a Bridge St, Manchester 3, appointed liquidator as from 28 March.

Domestic Appliances (Doncaster) Ltd. Creditors to send details to liquidator: P. Cardwell, of Poppleton and Appleby, 93 Queen St, Sheffield 1, by 31 May.

H. N. Southorn (Engrs.) Ltd. Meetings of members and creditors to be held at 21 Waterloo St, Birmingham 2, on 7 May, at 10 and 10.15 a.m., respectively.

Carlton Electrical Co. Ltd. Mr H. F. Rudd, Ainsty Lodge, Poplar Ave, Wakefield, appointed liquidator as from 28 March.

Companies Winding-up

D. and R. Electricals Ltd., 1 Oglander Rd, S.E.15, electrical dealers.

The Official Receiver reported to the first meeting of creditors that no statement of affairs had been filed but claims notified amounted to £8,200 and did not include possible motor vehicle finance claims nor possible preferential claims for rates and P.A.Y.E. tax. Assets noted totalled £86.

The company, formed in Nov., 1958, had an issued capital of £200, and obtained its business mainly by distributing leaflets and following up inquiries received. Failure was attributed, by a director, to losses through the dishonesty of certain salesmen and customers failing to meet the instalments.

Creditors passed no resolution and the case was left with the Official Receiver as liquidator.

BUSINESS PROSPECTS

Aldridge C.C. Gray, 15 Bridge St, W.1, architect for 10 Morfield Industrial Estate Co. factories, Northgate.

Annfield Plain. J. H. Napper and Ptnrs., 133 Osborne Rd, Jesmond, Newcastle, architects for Ransom and Marles Bearings proposed 100,000 sq ft extensions.

Arbroath. W. J. Anderson, Balmoral Rd, Aberdeen, contractors for £250,000 Metal Box Co. factory.—**T.C.** Dean of Guild Court sanction 80 all-electric houses, Wynds and Barngreen redevelopment area. £155,000.

Armagh T.C. £64,000 Folley La indoor pool plans approved.

Bardas Atha Claith. Tender: five blocks flats at Bridgefoot St. Assistant City Manager.

Barnsley B.C. Tender: 600-place St. Helen's Secondary School. Dyson, Cawthorne and Coles, 25 Regent St.

Barry. British Geon plan £2 million plant.

Berkhamsted U.D.C. Tender: 104 Westfield houses. Engineer and Surveyor.

Berwick-on-Tweed. Newcastle R.H.B. plan £60,000 Infirmary enlargements.

Beverley. Leeds R.H.B. approve £35,000 Westwood Hospital Maternity block.

Birkenhead. Liverpool Hospital Bd plan Arrowe Pk hospital.

Birmingham. J. H. D. Madin, 83 Hagley Rd, Edgbaston, architects for £600,000 Norwich Union Insurance Soc office building, Edgbaston.

Blundeston. Home Office plan £143,750 prison.

Bootle. J. Brian Cooper, 30 St George St, W.1, architects for Central Land Investments, Netherfield Rd shops.

Brighton. B.C. K. R. Kensall, 50 Norfolk Sq, is quantity surveyor for £352,719 Boston St factory.

Brighton. Tamplins plan laboratory and offices at Phoenix Brewery, Phoenix Pl.

Bristol. K. Nealon and Ptnrs, 38 Orchard St, architects for Stone's £1¼ million 131 flats scheme, Henbury Hill.—W. H. Watkins, Gray and Prtnrs, 8 Colston Ave, architects for G. B. Britton and Sons Ledge Rd, Kingswood development schemes.

Carlisle. John Twiname, Allerdale Ho, Brighham, Cockermouth, contractor for £301,430 additions to Garlands Hospital.

Castle Ward R.D.C. Tender soon: 43 sodium lights at N. Gosforth. Surveyor.

Cheltenham. Pates Grammar School governors propose new Hesters Way school.

Chester. John Henshall, Pacific Bldgs, James St, Liverpool, plan Sealand trading estate extensions.

Chorley B.C. 120 dwellings Burgh La housing estate. Borough Engineer. California Engineering, Lord St, Bury, contractor for Perrite works extensions.

Colwyn Bay. Quinton Hazell plan Mochdre factory extensions.

Croydon. Croythorne Properties Ltd, 23 Welbeck St, W.1, plan Thornton Rd offices.

Dagenham. Fletcher, Brock and Collis, Fowler Rd, Ilford, plan Hainault Rd factory extensions.

Dalkeith T.C. Tender: 48 Woodburn Gro houses. Burgh Architect.

Dewsbury B.C. Tender: Conversion of Victoria Rd premises for street lighting dept. Borough Architect.

Doncaster. Walker and Slater, Uttoxeter Old Rd, Derby contractors for £83,611 Royal Infirmary residential block.

Downpatrick U.D.C. 64 houses, Cleland's Stackyard site proposed.

Droitwich R.D.C. Tender: 16 flats Ombersley Housing site. Clerk of the Council.

Dumbarton B.C. Tender: 170 houses Leven St and Townend Rd. Town Clerk.

Dunoon. Dept of Health plan £250,000 hospital.

Dunstable. Howard, Fairbairn and Ptnrs, 81 Piccadilly, W.1, architects for 509,000 sq ft Vauxhall Motors factory.

Durham. Marshall Sisson, Farm Hall, Manchester, architect for University's New Elvet art dept.—tenders soon; Gilesgate junior school: A. J. Rossi, 88 Medomsley Rd, Consett, architect.—J. T. Bell and Son contractors for stages 2 and 3 Carrville estate houses.

Eastbourne. G. T. Culpitt and Sons, 42a Commercial Rd propose 10,000 sq ft Brampton Rd factory.

East Sussex C.C. Tender: Kitchen alterations and central heating, Stafford Hse, Keymer. County Architect.

Edenbridge. J. J. Stevens and Sons quantity surveyors for two L.C.C. factory blocks.

Enfield B.C. Tender: Library and rates offices, High St, Town Clerk.

Gateshead B.C. tenders shortly: Elgin Sec. Technical School. Borough Engineer.

Glouc. I.C.I. plan £10 million plant additions.—**C.C.** Tender: New Fairford fire station. County Architect.

Gosport. Thomas Jolly, Grant and Kelsey, 26 Kent Rd, Southsea, architects for Cyanamid's Fleetland Shipyard extension scheme.

Grangemouth. British Hydrocarbon Chemicals propose £5 million extensions.

Grays. L. J. Couves and Ptnrs, Grainger Chmbrs, Newcastle, architects for £58,000 Thomas Hedley factory, West Thurrock.

Halifax. Leeds R.H.B. plans £200,000 hospital accommodation scheme, Warley House.

Hamps C.C. Tender: Sharps Copse 20,000 sq ft Junior school. County Architect.

Harlow. N.E. Met R.H.B. plan completion of stage four Harlow Hospital authorised by Ministry.

Hebburn-on-Tyne. R. Bowey and Son, Wm. St Sth, Gosforth, contractors for George Angus and Co. Prince Consort Rd works extensions.

Herts C.C. propose £215,000 Broxbourne Grammar School. County Architect.

Hexham. W. Robb and Son, Fore St rebuilding plans approved.

Hull. M. of Works £101,500 Custom house planned.

Invergowerie. Tender: 34 houses Kingoodie. Secretary, Scottish Special Housing Assn, 19 Palmerston Pl, Edinburgh 12.

Inverkeithing. Tender: electrical installation, Civic Centre. Town Clerk.

Jarrow-on-Tyne. Matkin and Hawkins, Barclays Bank Chmbrs, Fawcett St, Sunderland, architects for Pyman Bell and Co., Straker St sawmill and offices.

Larkhall. Wylie, Shanks and Underwood, 12 Clairmount Gdns, Glasgow, architects for £172,000 S. Simpson factory extension.

Liskeard. Blamey and Morcom, Pavlova Wks, Barn St, propose £100,000 offices and stores.

London. S. Abel, 11 Arkely La, Barnet, architect for Simms Motor Units Oak La warehouse.—P. Hicks, 11 Duke St, W.1, architects for proposed Bankside printing works, S.E.1.—G. L. Hearn and Ptnrs, Kings Head Yd, Borough High St, S.E.1, plan Southall Pl factory extensions.—City Corpn granted building lease for Wates' London Wall offices site.—Arding and Hobbs, Clapham Junc. plan stores extensions, Battersea.—Trehearne and Norman Preston and Ptnrs, architects for St John's Wood Rd, N.W.8 site development.—Lewis Solomon, Kaye and Ptnrs, Thavies Inn Ho, Holborn Circus, architects for £3 million "London Hilton Hotel", W.1.—Raymond Spratley and Ptnrs, 9 Hertford St, W.1, architects for Rodwell Group Green Lane office block, N.21.

Londonderry. Min. of Education propose £150,000 Foyle College, Springtown.

Luton. Gardner and Revell, 20 Strathmore Rd, plan Brunswick St factory.—Dell and Pratt, Rambridge Foundry to erect Moreton Rd moulding shop.

Lytham St. Anne's B.C. Recommended to approve Fylde Footwear Co. Durham Ave factory extensions.

Maidstone B.C. plans transformer plant at Fairmeadow car park; also plan £80,000 St Faith St library.

Manchester. Salford R.C. Diocesan Trustees propose Clare Rd, Levenshulme primary school.—A. Levine and Sons, 41 Dutton St, plan two-storey Dutton Rd factory.

Margate. New Ideal Homesteads, Mead Ho, S. St, Epsom, plan Ramsgate Rd hotel.

Middlesbrough. Met Rly Surplus Land Co, propose £500,000 Dundas St redevelopment.— **T.C.** Tender soon: 29 houses, Easterside, Borough Engineer.

Middlesex. North Middx Hospital £23,992 operating theatre planned.

N. Riding. E.C. Hadfield, Cawkwell and Davidson, 17 Broomsgrove Rd, architects for stage 2, Brotton Modern School.

Newburn-on-Tyne. Metal Box Co, Baker St, plan Newburn industrial trading estate factory.

Newbury R.D.C. Approved R. Bird's Hambridge Rd factory plan.

Newcastle. W. B. Edwards and Ptnrs., Claremont Bldgs, architects for proposed Kings College Dept of Agriculture, College Ave.

Northumberland C.C. Cawood Wharton and Co., Harrowgate, contractor for stage one £20,000 Dinnington Primary School.

Nottingham. Land and Gen Devepts, 8 Berkeley St, W.1 plan block of flats, Trent Bridge.

Oldbury B.C. Tender: 78 4-storey dwellings, Stone St and Lodge St. Town Clerk.

Oldham C.B. Tender: 125 houses, Fitton Hill.

Perthshire. War Dept plans £210,000 works at Queen Victoria School, Dunblane.

Peterhead. Scottish Industrial Estates, contractors for Radiation Ltd factory.

Plymouth. Griffin and George, Frederick St, Birmingham 1, plan 36,000 sq ft Pennycross factory.—H. Terry and Sons, Redditch, plan Devonport factory.

Portadown. Min. of Commerce propose 52,600 sq ft Carricklacker factory.

Portsmouth. Die Casting Machine Tools plan £100,000 Eastern Rd factory.

Redditch. Planning applications: A. Farr and Sons, High St, Astwood Bk, new Double Century Wks factory block.— E. D. Rickards, Wellington Wks, High St, Astwood Bk factory extensions, Queen St.

Romford. Roff Marsh, 125 London Rd, Chelmsford, architects for L. F. Stone stores enlargements.

Rotherham. Mappins Brewery, Greaseborough Rd, propose new hotel, Moor Lane, North.

Scarborough. E. Allen, 31 St. Nicholas St, architect for Scarborough and District Newspapers' Aberdeen Walk printing works additions.

Sheffield. Cole Bros, Fargate 1, propose stores/multi-storey car park, Cambridge St.

Shrewsbury. Regent Oil Co, 177 Pk St, W.1, plan multi-storey Bridge St car park.

Southampton. Potter and Hare, De Vaux Ho, Salisbury, architects for 18-storey University accommodation block.

Taunton B.C. Tender: Five blocks Lane estate flats. Borough Architect.—Goodwin and Tatum, 6 Bedmord Row, W.C.1, architects for £400,000 Somerset C.C. offices.

Tottenham. Prince of Wales General Hospital new X-ray suite development planned.

Totnes R.D.C. Proposed installation of three or four additional lighting points and five-amp socket-outlets in most pre-war council houses.

W. Riding C.C. Tender: Penistone Thurlstone School kitchen installation.—Kirkburton Shepley School kitchen reorganisation. Clerk of Council.

MEETINGS TO NOTE

THURSDAY, 14 APRIL

I.E.E. (W. Wales Sub-Centre). "Electronic Applications in a Modern Steelworks," J. K. Edwards. Conference Room, S.W.E.B. Showrooms, The Kingsway, Swansea. 6 p.m.

A.S.E.E. (Bradford Branch). "Design and Safety of Electrical Installations and Apparatus," F. Clarke. Midland Hotel. 7.30 p.m.

TUESDAY, 19 APRIL

I.E.E. (S.E. Scotland Sub-Centre). "The Application of Irradiation in Industry," M. C. Crowley-Milling. Carlton Hotel, North Bridge, Edinburgh. 7 p.m.

I.E.E. (Oxford District). "Power Factor Correction of Industrial Electricity Supplies," R. O. M. Powell. Council Chmbr, Town Hall, Oxford. 7 p.m.

A.S.E.E. (Aldershot Branch). "Silicones in the Electrical Industry," P. R. A. Cherrett. Queens Hotel, S. Farnborough. 7.30 p.m.

WEDNESDAY, 20 APRIL

I.E.E. (S.W. Scotland Sub-Centre). "Some considerations in the Application of Power Rectifiers and Convertors." Institution of Engineers and Shipbuilders, 39 Elmbank Cres, Glasgow C.2. 6 p.m.

I.E.E. (Southern Centre). "Machine Translation of Languages," A. D. Booth. Farnborough Technical College, Boundary Rd. 6.15 p.m.

A.S.E.E. (Wolverhampton Branch). "Some Aspects of Electric Arc Welding," J. K. Johanneson. Chamber of Commerce, District Bank Chmbrs, Lichfield St. 7.45 p.m.

INSTITUTION OF PRODUCTION ENGINEERS (N. Midlands Region). "Radio Isotopes in Engineering," W. D. Busbridge. Conference Room, Peterscourt, Peterborough. 7.30 p.m.

THURSDAY, 21 APRIL

I.E.E. (S. Midland Centre). "The Jodrell Bank Radio Telescope," C. M. Kington. G.E.C. Ballroom, Telephone Wks, Stoke, Coventry. 7 p.m.

A.S.E.E. (Preston Branch). Social evening. R.A.F.A. Club, East View.

INSTITUTE OF PHYSICS (N.E. Branch). "The Jodrell Bank Telescope," H. A. Prime. Cleveland Scientific and Technical Institute, Middlesbrough. 6.30 p.m.

INSTITUTE OF PHYSICS (Midland Branch). A.G.M. The University, Birmingham. 5 p.m.

BRITISH INSTITUTION OF RADIO ENGINEERS (Medical Electronics Group). "Electro-Physiology," Dr J. G. Nicholls. London School of Hygiene and Tropical Medicine, Keppel St, W.C.1. 6.30 p.m.

FRIDAY, 22 APRIL

I.E.E. (Education Discussion Circle). "Broadening University Courses." Savoy Pl. 6 p.m.

I.E.E. (Sheffield Sub-Centre). Dinner/dance at Victoria Hotel. 7.30 p.m.

I.E.E. (N. Staffs Sub-Centre). "The Application of Transistors to Line Communication Equipment," H. T. Prior, D. J. R. Chapman and A. A. M. Whitehead. Duncan Hall, Stone. 7 p.m.

INSTITUTE OF PHYSICS (Midland Branch). Annual dinner. Birmingham University Union. 7 p.m.

MONDAY, 25 APRIL

I.E.E. (S. Midland Electronics and Measurement Group). "The Challenge of the Propagation Medium to the Radio Engineer," G. Millington. James Watt Memorial Institute, Birmingham. 6. p.m.

I.E.E. (London Graduate and Student Section). "Microwave Techniques," K. C. Kao. Savoy Pl. 6.30 p.m.

IPSWICH AND DISTRICT ELECTRICAL ASSOCIATION. "Application of Electronic Computers," P. Tainsh. Electric Hse, Ipswich. 7.15 p.m.

I.E.S. (Leicester Centre). A.G.M. Demonstration Theatre, E. Midlands E.B., Charles St. 7 p.m.

CONTRACTS PLACED

Ammanford U.D.C. Rewiring 73 houses. E. J. Daniels, £2,076.

Halesowen B.C. Supply and erection of 77 Class "A" and 616 Class "B" street lighting units, General Electric Co. Ltd., £13,738. Recommended.

Newcastle upon Tyne. Hospital work for Regional Board: lift installation, new neurological centre Newcastle General, Pickerings Ltd., £17,772; electrical work in new neurological centre, F. H. Wheeler and Co., £28,938; electrical work Bishop Auckland General, additions, F. Warren, £1,018; electrical work plastic surgery theatre Newcastle General, Cairns Ltd., £1,627; automatic contactor panel for Shotley Bridge, Contactor Switchgear Ltd., £690.

Oxford T.C. Supply and erection of steel columns and 280 W sodium lanterns on A40, northern bypass, Abacus Eng. Ltd.

South Shields T.C. Electrical installation in Cleadon Pk Secondary School additions, A. J. Wares Ltd., £4,087.

Southampton B.C. Electrical installation at Biterne Pk Junior School, Dicks Ltd., £1,214: lighting improvement at King Edward VI School, Groves and Co., £2,814. Recommended.

Sunderland T.C. Wiring of 336 and 253 houses at Town End Farm, John Calvert (Electrical) Ltd., £7,483 and £5,766.

Walthamstow B.C. Electrical installations at Outwood Common housing estate, Holliday, Hall and Stinson Ltd., £6,426. Recommended.

West Hartlepool T.C. Electrical installation in Brierton Hill Secondary Technical School, North of England Eng. and Electrical Co. Recommended.

NEW COMPANIES

Extracted from the Register issued by Jordan and Sons Ltd., 116 Chancery La, W.C.2.

Attwood Electronics Ltd. Nom. cap.: Dirs.: Bedford G. W. Attwood, Kings Hill, Berkhamsted, Herts, Kenneth Jones and George F. Tood.

W. H. Bastin and Son (Electrical) Ltd., 77 Barking Rd, E.6. Electrical contractors, etc. Nom. cap.: £1,000. Dirs.: William H. Bastin and Mrs May D. F. Bastin.

Brytarc Ltd., 642 Scott Hall Rd, Leeds 17. Manufacurers of and dealers in electrical apparatus, etc. Nom. cap.: £2,500. Dirs.: Matthias Rivlin and Mrs Estelle Rivlin.

E. V. Bullen and Son Ltd., 85/7 Hither Green La, S.E.13. Electrical and general engineers and contractors, etc. Nom. cap.: £2,000. Dirs.: John G. Bullen and Mrs Dorothy Bullen.

Burndept Holdings Ltd. Manufacturers of and dealers in radio and television equipment, etc. Nom. cap.: £100. Dirs.: to be appointed by subs. Subs.: Burndept Ltd., 681 Salisbury Hse, London Wall, E.C.2; Burndept Ltd. and Roy P. Taylor, 3 Beechcroft Rd, Orpington (jointly).

J. and J. Burtenshaw Partners Ltd. Electrical engineers and contractors, etc. Nom. cap.: £100. Dirs.: to be appointed by subs. Subs.: Alan A. Hinderer, Copthall Hse, Copthall Ave, E.C.2: and Janet E. Culverhouse, 3 Hyde Rd, Bexleyheath, Kent.

Chitnis Electronics Ltd. Nom. cap.: £100. Dirs.: to be appointed by the subs. Subs.: Gopal G. Chitnis, 34 Glenloch Rd, N.W.3 and Monika R. Barthel.

Davis C.R. Tubes Ltd., 34a Church St, Eastbourne. Electrical engineers and consultants, manufacturers of and dealers in cathode ray tubes, etc. Nom. cap.: £100. Dir.: Alfred V. W. Davis.

Electro Co. (of Doncaster) Ltd., 29 Thorne Rd, Doncaster, Yorks. To take over business of dealers in domestic electrical equipment and appliances carried on at Doncaster by Wm. and Sydney Kirsopp. Nom. cap.: £5,000. Dirs.: William C. Kirsopp and Sydney Kirsopp.

Govier and Poulter Ltd., 7 North St, Luton, Beds. Electrical engineers and general electrical installation contractors, etc. Nom. cap.: £1,000. Dirs.: William G. Govier and Kenneth R. Poulter.

Insta-Heat Ltd. Manufacturers of and dealers in electrical and electronic apparatus, etc. Nom. cap.: £100. Dirs.: T. E. Styrin and L. Newton, 19 Roberts Ave, Leeds 9.

Instrument Screw Co. (Predecessors) Ltd. Manufacturers of screws and parts for electrical and scientific instruments, etc. Nom. cap.: £100. Dirs.: not named. Subs.: Ralph C. Hopton and John Kennedy, 9-12 Cheapside, E.C.2.

Marshall and Baker Ltd. Manufacturers of and dealers in electrical lamps, fittings, etc. Nom. cap.: £100. Dirs.: Albert E. Marshall and Ivy M. Baker, 110 Woodhill, S.E.18.

E. H. and V. Moore (Glass) Ltd. Manufacturers of and dealers in electrical wireless valves, cathode ray tubes, etc. Nom. cap.: £1,000. Dirs.: Edward H. Moore and Mrs Victoria Moore, 4 Walton La, Weybridge, Surrey.

Mountergate Electrics Ltd., 45-51 St. John St, Mountergate, Norwich. To carry on business of electrical, radio and television engineers, etc. Nom. cap.: £100. Permanent dirs.: Alfred Marcantonio and Anina Marcantonio.

Pedrawl Fittings Ltd. Manufacturers of and dealers in domestic and household and general electric and other equipment, etc. Nom. cap.: £500. Dirs.: Leonard J. W. Pedley, 31 Deyncourt Gdns, Wanstead, E.11; and Fdk. J. G. Rawlins.

Probectors Ltd., Bucklersbury Hse, Bucklersbury, E.C.4. Manufacturers of and dealers in electrical and electronic equipment, etc. Nom. cap.: £1,600. Dirs.: George A. Elsmore, Hurbert S. Stevens and Fredk. G. Hawkins.

Pye T.V.T. Ltd. Manufacturers of and dealers in radio and television transmitting and receiving equipment, etc. Nom. cap.: £100. Dirs.: not named. Subs.: Jas. A. Cowell, 11 Lichfield Rd, Cambridge: and Raymond Halksworth, 60 Hartington Grove, Cambridge.

S.A.M.E.S. (Gt. Britain) Ltd. To manufacture and deal in electrical apparatus, etc. Nom. cap.: £2,000. Dirs.: Pierre Longy and Dr A. W. Bright. Subs.: Edward A. Clarke and Cyril F. J. Wiggington, 5 New Court, Lincoln's Inn, W.C.2.

Scotts Engineering (Newport) Ltd. Nom. cap.: £100. Dirs.: to be appointed by subs. Subs.: George D. Bertram, 94 Temple Park Cres, Edinburgh: and Robert T. Shiels, 54 Corstorphine Park Gdns, Edinburgh.

Sheerlite Ltd., 2a The Broadway, Penn Rd, Beaconsfield. Manufacturers of and dealers in electrical, gas and oil lamps, etc. Nom. cap.: £500. Dirs.: Wm. F. Pethick and Lionel Benn.

Spalding Electrical Ltd., 354 Lower Addiscombe Rd, Croydon. Manufacturers of and dealers in electrical, radio and mechanical apparatus, etc. Nom. cap.: £1,000. Dirs.: Geoffrey B. Spalding and Mrs M. E. Spalding.

W.E.A. Lectric Ltd. Nom. cap.: £500. Dirs.: Kenneth J. Adney, The Pines, Castle Rd, Camberley: Hilary B. Walklett, 3 Winton Rd, Reading; and Leon H. D. Eden.

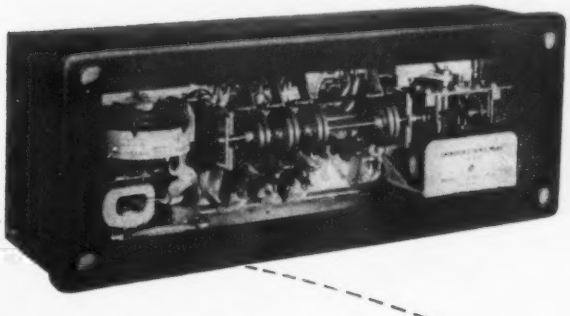
Welex Electrical Ltd., 27 Sandpit Rd, Welwyn Garden City. Electricians, etc. Nom. cap.: £400. Dirs.: Charles E. Kemp and Eric A. Rusch.

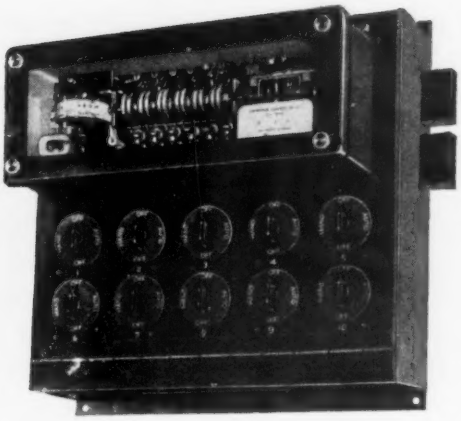
Wimo Parts Ltd. Manufacturers of and dealers in motor car lamps, electric bulbs, etc. Nom. cap.: £1,000. Dirs.: to be appointed by subs. Subs.: Rita L. Nani, 206 Westbourne Park Rd, W.11; and Beryl W. Reece, 38a St. Andrew's Sq, Surbiton, Surrey.

Choose AEI relays and correct Power Factor AUTOMATICALLY

Type NJO4 relay for the control of single-step power capacitors.

A complete range of AEI relays is available for the control of capacitors as a means of improving the power-factor of industrial loads. Please write for full details.





Type NJO3 relay for the control of a number of capacitors or capacitor sections in sequence. It may be switchboard or wall-mounting pattern with or without control switches

AEI

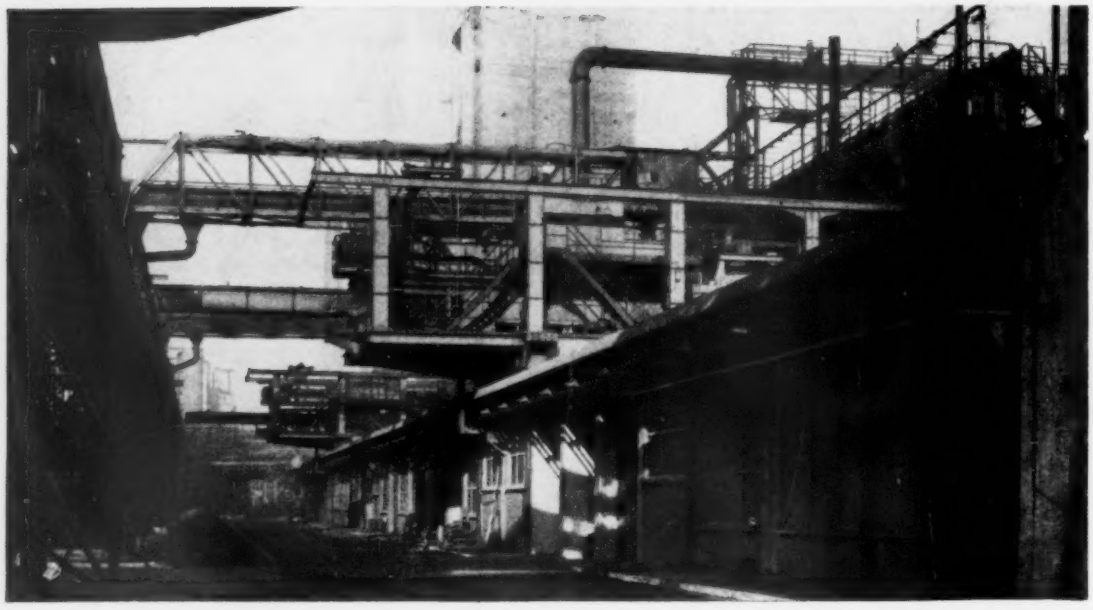
All enquiries should be addressed to the local AEI office or direct to—

Associated Electrical Industries Limited

INSTRUMENTATION DIVISION - Instrument & Meter Department

Trafford Park, Manchester 17

G/A 704



The ram side of the 66 coke oven battery at Manvers Main

Courtesy of National Coal Board & Simon Carves Ltd

MICROsen again——

——— crops up everywhere and not only on cranes and hoists. In this case it is incorporated in E.M.B. Control Gear Equipment for locating the ram beam exactly opposite to each oven to eject the red hot charge of coke. The MICROsen, which gives variable speeds ranging from 10% to full synchronous speeds, can be applied to any standard slip ring motor from 2 to 140 H.P.

THE SIGN OF QUALITY EMB ESTABLISHED 1908

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CLASSIFIED ADVERTISEMENTS

TENDERS INVITED

COUNTY BOROUGH OF BLACKPOOL

TENDERS invited for the supply of the following equipment for the Electrical Services Department:

(a) Group "A" Post top Fluorescent Lanterns including control gear.

(b) Special Cast Iron spigots for Post top Fluorescent Lanterns.

Specification, Drawing, Tender and General Conditions from Director of Lighting and Electrical Services, Rigby Rd East, Blackpool, to be returned by 10 a.m., 27 April, 1960. (P 628)

BOROUGH OF EALING

Street Lighting—Uxbridge Road and Boston Road, Class "A"

CONTRACT "A"

SUPPLY of 106—3 x 80 watt fluorescent lanterns complete with lamps, and 46—400 watt MBF/U lanterns complete with control gear and lamps.

CONTRACT "B"

Supply and erection of 150—25 ft mounting height steel columns.

Details obtainable from Borough Engineer, Town Hall, Ealing, W.5, on payment of £5 for each tender.

Returnable on receipt of a bona fide tender.

Tenders to Town Clerk, Town Hall, Ealing, W.5, by noon, 27 April, 1960.

E. J. COPE-BROWN,
Town Clerk.
(P 608)

TRUNK ROAD LIGHTING

London—Gt. Yarmouth T.R. A.12

STANWAY Parish Council invite TENDERS for a system of Group "A" Lighting, consisting of 19 No.—140 W Sodium Lanterns mounted on 25 ft Concrete Columns.

Details obtainable from H. C. Miller, Clerk to the Council, 24 Villa Road, Stanway, Colchester, Essex. (P 648)

APPOINTMENTS VACANT

NORTH THAMES GAS BOARD

WORKS ELECTRICAL ENGINEER

ENGINEERS, aged about 28, who have served a recognised apprenticeship and have a University Degree or Higher National Certificate, are invited to apply for the above appointment in the Board's Tar and Ammonia Products Works, Beckton, East Ham, E.6. This works has undergone extensive reconstruction in recent years.

Duties will include the erection and maintenance of electrical equipment of high and low voltage, including switchgear, transformers, rectifiers, generators and motors associated with continuously operating process plants.

Previous experience in heavy industry or at a Chemical Works will be an advantage.

Starting salary within the region of £1,050 per annum.

Applications giving full details should be sent to the Staff Controller, North Thames Gas Board, 30 Kensington Church St, quoting reference ET/794. (P 633)

ADMINISTRATIVE COUNTY OF LEICESTER

ASSISTANT ELECTRICAL ENGINEER, £780/£1,070 according to qualifications. Candidates should be in possession of the Higher National Certificate in Electrical Engineering and be capable of preparing schemes for electrical installations in all types of buildings.

Lodging allowance and removal expenses may be paid to married men.

Apply to County Architect, 123 London Rd, Leicester. (P 625)

COUNTY BOROUGH OF BLACKPOOL

Lighting and Electrical Services Department

APPLICATIONS invited from good draughtsmen with general electrical and/or lighting experience to Ordinary National Certificate Standard for appointment of Technical Assistant. Salary: £610/£765 commencing according to circumstances. Forms and conditions (from Director of Lighting and Electrical Services, Rigby Rd East, Blackpool) returnable by 2 May. (P 630)

MIDLANDS ELECTRICITY BOARD

APPLICATIONS are invited for the following superannuable posts:

Central Gloucestershire Sub-Area

THIRD ASSISTANT DISTRICT COMMERCIAL ENGINEER (DEAN FOREST)

Applicants should have had wide practical experience in the sale and installation of domestic and commercial electrical equipment and the work associated therewith. The successful applicant will be required to assist in all branches of commercial work, including advising consumers on domestic, commercial, and industrial equipment, estimating, contracting work and public lighting. Technical qualifications desirable. Salary £710/£755 per annum (N.J.B. Grade E.10).

SERVICE CENTRE SUPERVISOR (MALE) (NEW SERVICE CENTRE AT CINDERFORD, DEAN FOREST)

The successful applicant to be responsible for the Centre. Experience in all Service Centre duties necessary. Salary £640/£700 per annum (N.J.C. Grade 2).

Apply, by letter, within 14 days, stating age, experience, present position and salary to Mr S. Raybould, Sub-Area Manager, Midlands Electricity Board, Eastern Ave, Gloucester.

Wolverhampton and District Sub-Area

FIRST ASSISTANT DISTRICT COMMERCIAL ENGINEER (WOLVERHAMPTON)

Applicants should have a sound commercial background including a thorough knowledge of sales promotion methods, and have had experience of all types of electrical equipment, appliances and installations. Duties will include the supervision of Service centres, Demonstrators and Outside Sales Representatives. Appropriate qualifications desirable. Salary £1,195/£1,270 per annum (N.J.B. Grade J.6). Apply, by letter, within 14 days, stating age, qualifications, experience, present position and salary to Mr D. Holt, Sub-Area Manager, Midlands Electricity Board, 83 Darlington St, Wolverhampton.

F. W. CATER,
Secretary.
(P 640)

THE NORTH EASTERN ELECTRICITY BOARD

Wear Sub-Area

APPLICATIONS are invited for the appointment of Chief Draughtsman, Sub-Area Engineer's Department, with location at Sub-Area Headquarters, Dunning Street, Sunderland.

Applicants should have experience in preparing and maintaining Mains Records and electrical layout drawings connected with Board's substations and equipment. Knowledge of building construction and architectural work an advantage. Appropriate technical qualifications desirable.

Salary: N.J.B. Schedule D, Grade 3, £1,055/£1,155. N.J.B. conditions of service.

Applications stating age, qualifications and experience to be received by Assistant Secretary (Establishments), The North Eastern Electricity Board, G.P.O. Box No. 117, Carliol Hse, Newcastle upon Tyne, within ten days of the appearance of this advertisement. (P 643)

RHODESIA AND NYASALAND

APPLICATIONS are invited for the post of LECTURER IN ELECTRICAL ENGINEERING SUBJECTS at the Polytechnic, Salisbury. The Lecturer will be required to lecture in Electrical Engineering subjects up to general degree standard and, in addition, the electrical content of the City and Guilds Electrical Fitters' Course, for whch a sound practical training is essential.

Salary Scale: £1,365 x £52 10s—£1,837 10s.

Up to six increments are allowed for previous recognised experience.

The appointment is permanent and pensionable but consideration would be given to a three-year contract. Passages of the Lecturer, his wife and dependant children will be paid for the outward journey; if the post is filled on contract terms return passages will be paid.

Generous vacation leave is granted. Facilities for the education of children in Salisbury are excellent.

For further information and application forms please apply to: The Education Liaison Office, Rhodesia Hse, 429 Strand, London W.C.2. (P632)

SOUTHERN ELECTRICITY BOARD

DEMONSTRATOR

WEYMOUTH District of No. 4 (Bournemouth) Sub-Area. Salary: N.J.C. Grade 1 (£525/£625 per annum). N.J.C. conditions of service.

Applicants should be qualified to advise generally on the utilisation of electric domestic appliances, to give public demonstrations of apparatus and to assist in showroom duties. The possession of an E.A.W. Certificate or equivalent Domestic Science qualification would be an advantage.

The successful candidate will be required to contribute to the Electricity Supply (Staff) Superannuation Scheme, if eligible.

Applications on forms obtainable from the Sub-Area Secretary, 1 Priory Rd, Bournemouth, and returned to him, quoting Z.1159, not later than 30 April, 1960.

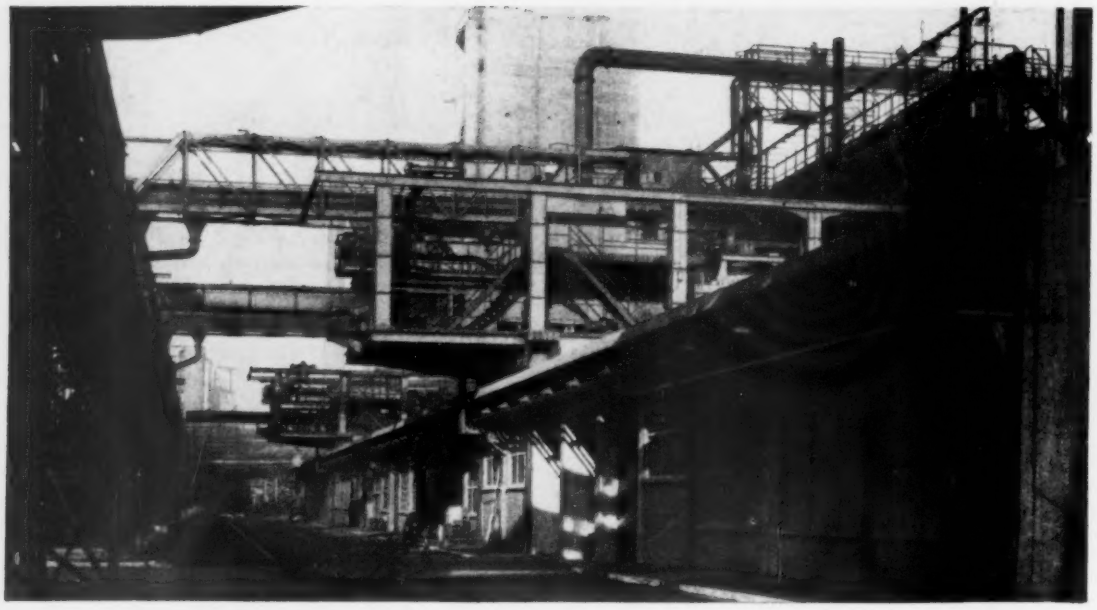
FITTER (ELECTRICAL)

Construction Department, East Sub-Section, of No. 2 (Newbury) Sub-Area, based at Newbury. Pay and conditions of service in accordance with N.J.I.C. Agreement. Present rate 5s 1½d per hour for 42-hour 5-day week.

The duties of the post will include the erection and connection of H.V. and L.V. switchgear, plant and control gear in substations.

Applications, in writing, to the Sub-Area Secretary, 7 Oxford Rd, Newbury, quoting Z.1184, not later than 30 April, 1960. (P 634)

Advertisements should be sent to the Classified Advertisement Dept., Electrical Times, Sardinia House, Sardinia Street, London, W.C.2, before 10 a.m. on TUESDAY of the week of issue. Official Displayed Advertisements are charged at 40s. per inch, and all other classified advertisements at 3s. per line. Situations Wanted four insertions at twice the single insertion rate. Fee for Box Number and postage on replies 2s.



The ram side of the 66 coke oven battery at Manvers Main

Courtesy of National Coal Board & Simon Carves Ltd

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(a) Group "A" Post top Fluorescent Lanterns including control gear.

(b) Special Cast Iron spigots for Post top Fluorescent Lanterns.

Specification, Drawing, Tender and General Conditions from Director of Lighting and Electrical Services, Rigby Rd East, Blackpool, to be returned by 10 a.m., 27 April, 1960. (P 628)

BOROUGH OF EALING

Street Lighting—Uxbridge Road and Boston Road, Class "A"

CONTRACT "A"

SUPPLY of 106—3 x 80 watt fluorescent lanterns complete with lamps, and 46—400 watt MBF/U lanterns complete with control gear and lamps.

CONTRACT "B"

Supply and erection of 150—25 ft mounting height steel columns.

Details obtainable from Borough Engineer, Town Hall, Ealing, W.5, on payment of £5 for each tender.

Returnable on receipt of a bona fide tender.

Tenders to Town Clerk, Town Hall, Ealing, W.5, by noon, 27 April, 1960.

E. J. COPE-BROWN,
Town Clerk.
(P 608)

TRUNK ROAD LIGHTING

London—Gt. Yarmouth T.R. A.12

STANWAY Parish Council invite TENDERS for a system of Group "A" Lighting, consisting of 19 No.—140 W Sodium Lanterns mounted on 25 ft Concrete Columns.

Details obtainable from H. C. Miller, Clerk to the Council, 24 Villa Road, Stanway, Colchester, Essex. (P 648)

APPOINTMENTS VACANT

NORTH THAMES GAS BOARD

WORKS ELECTRICAL ENGINEER

ENGINEERS, aged about 28, who have served a recognised apprenticeship and have a University Degree or Higher National Certificate, are invited to apply for the above appointment in the Board's Tar and Ammonia Products Works, Beckton, East Ham, E.6. This works has undergone extensive reconstruction in recent years.

Duties will include the erection and maintenance of electrical equipment of high and low voltage, including switchgear, transformers, rectifiers, generators and motors associated with continuously operating process plants.

Previous experience in heavy industry or at a Chemical Works will be an advantage.

Starting salary within the region of £1,050 per annum.

Applications giving full details should be sent to the Staff Controller, North Thames Gas Board, 30 Kensington Church St, quoting reference ET/794. (P 633)

ADMINISTRATIVE COUNTY OF LEICESTER

ASSISTANT ELECTRICAL ENGINEER, £780/£1,070 according to qualifications. Candidates should be in possession of the Higher National Certificate in Electrical Engineering and be capable of preparing schemes for electrical installations in all types of buildings.

Lodging allowance and removal expenses may be paid to married men.

Apply to County Architect, 123 London Rd, Leicester. (P 625)

COUNTY BOROUGH OF BLACKPOOL

Lighting and Electrical Services Department

APPLICATIONS invited from good draughtsmen with general electrical and/or lighting experience to Ordinary National Certificate Standard for appointment of Technical Assistant. Salary: £610/£765 commencing according to circumstances. Forms and conditions (from Director of Lighting and Electrical Services, Rigby Rd East, Blackpool) returnable by 2 May. (P 630)

MIDLANDS ELECTRICITY BOARD

APPLICATIONS are invited for the following superannuable posts:

Central Gloucestershire Sub-Area

THIRD ASSISTANT DISTRICT COMMERCIAL ENGINEER (DEAN FOREST)

Applicants should have had wide practical experience in the sale and installation of domestic and commercial electrical equipment and the work associated therewith. The successful applicant will be required to assist in all branches of commercial work, including advising consumers on domestic, commercial, and industrial equipment, estimating, contracting work and public lighting. Technical qualifications desirable. Salary £710/£755 per annum (N.J.B. Grade E.10).

SERVICE CENTRE SUPERVISOR (MALE) (NEW SERVICE CENTRE AT CINDERFORD, DEAN FOREST)

The successful applicant to be responsible for the Centre. Experience in all Service Centre duties necessary. Salary £640/£700 per annum (N.J.C. Grade 2).

Apply, by letter, within 14 days, stating age, experience, present position and salary to Mr S. Raybould, Sub-Area Manager, Midlands Electricity Board, Eastern Ave, Gloucester.

Wolverhampton and District Sub-Area

FIRST ASSISTANT DISTRICT COMMERCIAL ENGINEER (WOLVERHAMPTON)

Applicants should have a sound commercial background including a thorough knowledge of sales promotion methods, and have had experience of all types of electrical equipment, appliances and installations. Duties will include the supervision of Service centres, Demonstrators and Outside Sales Representatives. Appropriate qualifications desirable. Salary £1,195/£1,270 per annum (N.J.B. Grade J.6). Apply, by letter, within 14 days, stating age, qualifications, experience, present position and salary to Mr D. Holt, Sub-Area Manager, Midlands Electricity Board, 83 Darlington St, Wolverhampton.

F. W. CATER,
Secretary.
(P 640)

THE NORTH EASTERN ELECTRICITY BOARD

Wear Sub-Area

APPLICATIONS are invited for the appointment of Chief Draughtsman, Sub-Area Engineer's Department, with location at Sub-Area Headquarters, Dunning Street, Sunderland.

Applicants should have experience in preparing and maintaining Mains Records and electrical layout drawings connected with Board's substations and equipment. Knowledge of building construction and architectural work an advantage. Appropriate technical qualifications desirable.

Salary: N.J.B. Schedule D, Grade 3, £1,055/£1,155. N.J.B. conditions of service.

Applications stating age, qualifications and experience to be received by Assistant Secretary (Establishments), The North Eastern Electricity Board, G.P.O. Box No. 117, Carliol Hse, Newcastle upon Tyne, within ten days of the appearance of this advertisement. (P 643)

RHODESIA AND NYASALAND

APPLICATIONS are invited for the post of LECTURER IN ELECTRICAL ENGINEERING SUBJECTS at the Polytechnic, Salisbury. The Lecturer will be required to lecture in Electrical Engineering subjects up to general degree standard and, in addition, the electrical content of the City and Guilds Electrical Fitters' Course, for which a sound practical training is essential.

Salary Scale: £1,365 x £52 10s—£1,837 10s.

Up to six increments are allowed for previous recognised experience.

The appointment is permanent and pensionable but consideration would be given to a three-year contract. Passages of the Lecturer, his wife and dependant children will be paid for the outward journey; if the post is filled on contract terms return passages will be paid.

Generous vacation leave is granted. Facilities for the education of children in Salisbury are excellent.

For further information and application forms please apply to: The Education Liaison Office, Rhodesia Hse, 429 Strand, London W.C.2. (P632)

SOUTHERN ELECTRICITY BOARD

DEMONSTRATOR

WEYMOUTH District of No. 4 (Bournemouth) Sub-Area. Salary: N.J.C. Grade 1 (£525/£625 per annum). N.J.C. conditions of service.

Applicants should be qualified to advise generally on the utilisation of electric domestic appliances, to give public demonstrations of apparatus and to assist in showroom duties. The possession of an E.A.W. Certificate or equivalent Domestic Science qualification would be an advantage.

The successful candidate will be required to contribute to the Electricity Supply (Staff) Superannuation Scheme, if eligible.

Applications on forms obtainable from the Sub-Area Secretary, 1 Priory Rd, Bournemouth, and returned to him, quoting Z.1159, not later than 30 April, 1960.

FITTER (ELECTRICAL)

Construction Department, East Sub-Section, of No. 2 (Newbury) Sub-Area, based at Newbury. Pay and conditions of service in accordance with N.J.I.C. Agreement. Present rate 5s 11d per hour for 42-hour 5-day week.

The duties of the post will include the erection and connection of H.V. and L.V. switchgear, plant and control gear in substations.

Applications, in writing, to the Sub-Area Secretary, 7 Oxford Rd, Newbury, quoting Z.1184, not later than 30 April, 1960. (P 634)

Advertisements should be sent to the Classified Advertisement Dept., Electrical Times, Sardinia House, Sardinia Street, London, W.C.2, before 10 a.m. on TUESDAY of the week of issue. Official Displayed Advertisements are charged at 40s. per inch, and all other classified advertisements at 3s. per line. Situations Wanted four insertions at twice the single insertion rate. Fee for Box Number and postage on replies 2s.

CENTRAL ELECTRICITY GENERATING BOARD
North Eastern and Yorkshire Region

TRANSMISSION DEPARTMENT
APPOINTMENT OF THIRD ASSISTANT ENGINEER

APPLICATIONS are invited for the appointment of a Third Assistant Engineer in the Transmission Engineer's Department, North Eastern Division, Newcastle upon Tyne, to be engaged primarily on the construction of major 275 kV and 132 kV overhead lines.

The successful candidate should be conversant with all aspects of the work, and with contract conditions, and have a sound knowledge of overhead line calculations. The candidate should possess technical qualifications equivalent to Corporate Membership of the Institution of Electrical Engineers.

The salary for this appointment (which is superannuable) will be in accordance with the National Joint Board Agreement, Grade 6, Schedule B (£925/£1,140 per annum), and will begin at a point commensurate with qualifications and experience.

Forms of application may be obtained from the Assistant Regional Secretary (Personnel), Central Electricity Generating Board, North Eastern and Yorkshire Region, 1 Whitehall Rd, Leeds 1, to whom they should be returned to arrive not later than 26 April, 1960. (P 611)

CENTRAL ELECTRICITY GENERATING BOARD
Eastern Division

APPLICATIONS are invited for the following appointment:

STATION SHIFT CONTROL ENGINEER
LUTON GENERATING STATION

Salary: N.J.B., Class E, Grade 10, £710 x £15—£755 per annum, plus £90 per annum Shift Allowance.

Applicants should preferably have followed a course of technical studies of Higher National Certificate standard, but consideration will be given to applicants with sound practical training and knowledge.

They should have had experience in the operation of a switchboard at a Generating Station and be fully conversant with high voltage switching operations and protective systems.

A knowledge of the operation of various types of D.C. Converting Plant would be an advantage.

Applications, quoting S.V. No. 1314, stating age, qualifications, experience and present position, should be sent to the Controller, Central Electricity Generating Board, Eastern Division, West Farm Pl, Chalk La, Cockfosters, Barnet, Herts, to arrive not later than 23 April, 1960. (P 610)

THE NORTH WESTERN ELECTRICITY BOARD

GENERAL ASSISTANT ENGINEER
(TELECOMMUNICATIONS)
ENGINEERING DEPARTMENT
AREA BOARD HEADQUARTERS

THE successful applicant will be concerned with the installation and maintenance of telecommunication apparatus with particular reference to V.H.F. radio. Some knowledge of automatic telephone, remote indicating, and supervisory control systems would be an advantage.

Salary Scale: £570/£725 p.a. Grade AX/EX 9. N.J.B. Conditions.

Application forms must be obtained from the Secretary, the North Western Electricity Board, Cheetwood Rd, Manchester 8, and returned to him by 30 April, 1960.

FOURTH ASSISTANT ENGINEER
POWER SALES SECTION
SUB-AREA COMMERCIAL DEPARTMENT
MANCHESTER

Applicants should have practical training in industrial electrification, with experience of D.C./A.C. changeover. Preference will be given to applicants holding H.N.C. in Electrical Engineering. Knowledge of tariffs and negotiation of supply terms will be an advantage.

Salary Scale: £910 x £15—£955 p.a., Grade M.13. N.J.B. Conditions.

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Application forms to be obtained from the Manager (Staff Vacancy), No. 1 Sub-Area, The North Western Electricity Board, Town Hall, Manchester, P.O. Box 493, and returned to him by 25 April, 1960.

THIRD ASSISTANT ENGINEER
(CIVIL ENGINEERING)
SUB-AREA ENGINEERING DEPARTMENT
PRESTON

Applicants should be suitably qualified and have had experience in preparing sketch schemes, working drawings, specifications and bills of quantities, in connection with new buildings (offices, substations, workshops, service centres, etc.); also setting out and supervision of work on site. Membership of the Royal Institute of British Architects will be an advantage.

Salary Scale: £1,025/£1,085 p.a., Grade L.10. N.J.B. Conditions.

Applications must be made on a form to be obtained from the Manager, No. 4 Sub-Area, The North Western Electricity Board, 40-41 Lune St, Preston, and returned to him so as to be received not later than 27 April, 1960. (P 619)

LONDON ELECTRICITY BOARD

ENGINEERING DRAUGHTSMAN

APPLICATIONS are invited for the above position in the Board's Contracting Section at Stratford Pl, W.1.

Candidates should have a good general and technical education and be in possession of the Ordinary National Certificate. They should be able to prepare working drawings from sketches and schematic layouts, and prepare the associated cable schedules.

The post is graded within Schedule D of the National Joint Board Agreement as Grade 6—£660/£780 per annum, inclusive of London Allowance.

Application form obtainable from Personnel Officer, 46 New Broad St, London E.C.2. Please quote ref.: PER/V/2921/T. (P 613)

EASTERN ELECTRICITY BOARD
Essex Sub-Area

TRAINEE DEMONSTRATOR
SOUTHEND DISTRICT
75/60.R.

CANDIDATES should have had Domestic Science training, a sound knowledge of electrical appliances, and experience in the Electrical Industry would be an advantage. Duties will include assistance to Demonstrators.

Salary: N.J.C. Scale £235/£526.

The successful candidate will be required to contribute to a superannuation scheme and may be required to undergo a medical examination.

Apply by letter to J. Linton, A.H.W.C., M.I.E.E., ASSOC.I.MECH.E., District Manager, Southend District, Eastern Electricity Board, 85 London Rd, Southend-on-Sea, Essex, by 29 April, 1960. (P 627)

NORTH OF SCOTLAND HYDRO-ELECTRIC BOARD
South Caledonia Area

APPLICATIONS are invited for the following appointment:

FIRST ASSISTANT DISTRICT ENGINEER
OBAN

(C.5, £860 x £15—£905). Candidates should be qualified to at least H.N.C. level, and have had a sound training with subsequent all-round experience of distribution. It is anticipated that the District Classification will rise to D next year. The commencing salary will be according to qualifications and experience. A car allowance will be payable.

Applications to be made on forms obtainable from the Area Manager, North of Scotland Hydro-Electric Board, South Caledonia Area, Blackfriars, Perth, and returned within 14 days marked "Confidential." (P 624)

SOUTH EASTERN ELECTRICITY BOARD

DISTRICT CHIEF CLERK
SUTTON DISTRICT

SALARY £1,070 x £30—£1,160 per annum plus £50 London Weighting per annum under N.J.C. Agreement, Grade 7. Applicants should have wide practical knowledge of all aspects of the work of the clerical department of a district, be experienced in the control of staff and be capable organisers.

Applications quoting ET and naming two referees on forms from Surrey Manager, Seeboard, Rough Rew, Ridgeway Rd, Dorking, Surrey, by 27 April, 1960.

ASSISTANT DISTRICT ENGINEER
TUNBRIDGE WELLS DISTRICT

Salary £815 x £15—£860 p.a., Class F, Grade 9. Preference given to applicants with technical qualifications up to H.N.C. standards and with practical experience of the operation, maintenance and construction of M.V. and 11kV underground and overhead systems. The successful candidate will be expected to undertake standby duty and to reside in or near Tunbridge Wells.

Applications quoting ET and naming two referees to District Manager, Seeboard, Town Hall, Tunbridge Wells, by 27 April, 1960.

GEORGE WRAY,
Secretary.
(P 626)

CITY OF SALISBURY
Southern Rhodesia

ELECTRICITY DEPARTMENT
VACANCIES FOR TECHNICAL ASSISTANTS
GRADE 2

APPLICATIONS are invited for the fixed establishment posts of Technical Assistants, Grade 2, in the Salisbury Municipality Electricity Department, on the scale £1,100 x £50—£1,250 p.a., plus 2½%. Commencing salary is at the minimum of the grade and no allowances are payable.

Candidates must be thoroughly experienced in all types of meter testing, particularly high tension, transformer operated, polyphase equipments, both kW and kVA, and should be capable of carrying out all duties in connection with a standardising laboratory.

The main duties of the posts are:

1. Testing and calibrating high tension and special types of metering;

2. Standardising instruments and substandard meters against potentiometer equipment;

3. Radio and phase angle testing of instrument transformers;

4. Testing all types of instruments and metres, and general supervision of metering work.

The appointments will be subject to the City Council's Service and Leave Regulations. A successful candidate will be required to furnish to the Council a satisfactory medical certificate of fitness and to serve a probationary period of not less than six months, and if thereafter confirmed in his appointment, to join the Southern Rhodesia Local Authorities' Joint Pension and Widows' and Orphans' Fund. He must also be able to comply with the requirements of the Federal Immigration Authorities.

Candidates must submit full particulars of their qualifications, training and experience, giving details of positions held and salaries received. Age, place of birth, nationality and marital state should be stated and copies of not more than three recent testimonials may be forwarded.

Particulars of the undertaking and a summary of conditions of service, pension and leave entitlements, etc., may be obtained from Messrs Davis and Soper Ltd., 52-54 St. Mary Axe, London E.C.3, to whom applications must be submitted on or before 30 April, 1960. (P 559)

Box No. replies to be addressed to the ELECTRICAL TIMES, Sardinia House, Sardinia Street, London, W.C.2

CENTRAL ELECTRICITY GENERATING BOARD
East Midlands Division

APPLICATIONS are invited for the following positions within the Division:

STATION SHIFT CONTROL ENGINEER
HIGH MARNHAM POWER STATION
Vacancy No. 83/60.

Applicants should have had a sound technical training and practical experience in a modern power station. Preference will be given to applicants who possess the Higher National Certificate or its equivalent.

The salary will be in accordance with Class L, Grade 10 (£1,025/£1,085 per annum) of the National Joint Board Agreement, plus 10% allowance for shift duties.

Closing date for receipt of applications: 29 April, 1960.

ASSISTANT ENGINEER (INSTRUMENTS)
DRAKELOW "A" AND "B" POWER STATIONS
Vacancy No. 88/60.

The selected candidate will be required to assist the Instrument Engineer in the maintenance, calibration and testing of modern power station instruments and controls.

Applicants should have sound technical qualifications and training, a knowledge of electronics and manufacturing experience would be an advantage.

The salary will be in accordance with Class M, Grade 10 (£1,095/£1,170 per annum) of the National Joint Board Agreement.

Closing date for receipt of applications: 29 April, 1960.

FOURTH ASSISTANT ENGINEER
COVENTRY SECTION
Vacancy No. 87/60.

Applicants should have experience of maintenance and operation of E.H.T. overhead lines, transformers and switchgear.

Preference will be given to candidates with qualifications leading to Corporate Membership of the Institution of Electrical Engineers.

Salary will be in accordance with Class AX/EX, Grade 8 (£735/£960 per annum) of the National Joint Board Agreement.

Closing date for receipt of applications: 29 April, 1960.

STATION SHIFT CONTROL ENGINEER
DERBY POWER STATION
Vacancy No. 89/60.

Applicants should have had a sound training and practical experience in a modern power station. The possession of a Higher National Certificate in Electrical Engineering, or its equivalent, would be an advantage.

Salary will be in accordance with Class F, Grade 10 (£765/£810 per annum) of the National Joint Board Agreement, plus £90 per annum shift allowance.

Closing date for receipt of applications: 29 April, 1960.

ASSISTANT SHIFT CHARGE ENGINEER
CASTLE DONINGTON POWER STATION
Vacancy No. 90/60.

Applicants should have received a sound technical training and have had experience in a modern power station. Preference will be given to candidates who possess the Higher National Certificate or its equivalent.

Salary will be in accordance with Class L, Grade 8 (£1,195/£1,270 per annum) of the National Joint Board Agreement, plus 10% allowance for shift duties.

Closing date for receipt of applications: 29 April, 1960.

These appointments will be pensionable within the terms and conditions of the Electricity Supply (Staff) Superannuation Scheme.

Applications should be submitted on the official form AE6/ACT which may be obtained from the Divisional Establishments Officer, Central Electricity Generating Board, East Midlands Division, P.O. Box 25, Barker Gate, Nottingham, and should be returned to the undersigned by the date stated.

O. S. WOODS,
Divisional Controller.

8 April, 1960. (P 649)

BIRMINGHAM TAME AND REA DISTRICT DRAINAGE BOARD

SENIOR ASSISTANT ELECTRICAL ENGINEER (UNESTABLISHED)

APPLICATIONS are invited for the appointment of a Senior Assistant Electrical Engineer on the staff of the Engineer to the Board, Rookery Park, Erdington, Birmingham 24. The salary will be in accordance with Grade IV (£1,025 x £50—£1,175) of the A.P. and T. Division of the National Salary Scales.

Applicants should have a degree in Electrical Engineering, or be Corporate Members of the Institution of Electrical Engineers and must have wide experience in the preparation of plans, estimates and the installation and maintenance of modern industrial plant up to 3·3 kV. Previous experience with a Local Authority is not necessary. Housing accommodation may be made available.

Applications, which must include date of birth, nationality, qualifications, appointments held and the names and addresses of two referees, must reach the undersigned not later than Monday, 25 April, 1960.

ARTHUR J. WRIGHT,
Clerk to the Board.

Clerk's Office,
Lombard Hse,
Great Charles St,
Birmingham.
5 April, 1960. (P 612)

RHODESIA AND NYASALAND

WORKSHOP INSTRUCTOR
ELECTRICAL TRADE

APPLICATIONS are invited for an appointment at the Technical College, Bulawayo. The instructor should be suitably qualified, preferably with a Full Technological Certificate in the Electrical Trade. He will be required to teach apprentice Electricians and Electrical Fitters undertaking City and Guilds Craft courses.

£735 x £52 10s—£787 10s x £78 15s—£945 x £52 10s—£1,050 x £105—£1,260 x £52 10s—£1,732 10s.

The starting salary is dependent upon qualifications and experience and will not be more than £1,155 p.a.

The appointment is permanent and pensionable. The passages of the Instructor, his wife and dependant children to Bulawayo will be paid. Generous vacation leave is granted and facilities for the education of children are excellent.

The post is advertised for Sept., 1960, but could be made available from 1 June, 1960.

For further information and application forms please apply to: The Education Liaison Officer, Rhodesia Hse, 429 Strand, London W.C.2.

Applications should be made as quickly as possible. (P 631)

BRADFORD INSTITUTE OF TECHNOLOGY

Principal: E. G. Edwards, PH.D., B.SC., F.R.I.C.

APPLICATIONS are invited for the post of

SENIOR LECTURER IN ELECTRICAL ENGINEERING

This rapidly expanding department offers exceptional opportunities for teaching, consulting and research work. Candidates should be suitably qualified to teach to final degree standard in Electrical Power and Machines or Electronics and Telecommunications. The successful candidate will be encouraged to develop industrial contacts and to undertake research, for which adequate facilities will be available.

Salary scale, £1,550/£1,750 per annum.

Previous industrial and research experience, at a suitable level, will be taken into account in fixing the commencing salary.

Further particulars and forms of application may be obtained from the Registrar, Bradford Institute of Technology, Bradford 7.

HENRY PATTEN,
Clerk to the Governors.
(P 653)

MERSEYSIDE AND NORTH WALES ELECTRICITY BOARD

CONSUMERS' ENGINEER

REQUIRED in the Liverpool North District of the Board's No. 1 Sub-Area. Salary within range £1,025/£1,085 per annum (N.J.B. J/8).

The duties include responsibility to the First Assistant District Commercial Engineer for the control and operation of the service section dealing with estimating and specifications for contracting work, advising consumers on electricity supply matters, etc.

Applicants should possess appropriate technical qualifications.

Appointment subject to medical examination. Pension Scheme.

Apply to the Manager, No. 1 Sub-Area, 24 Hatton Gdn, Liverpool 3, for special application forms, quoting Reference No. T.1. Closing date: 25 April, 1960.

Applications in respect of previous advertisement remain under consideration. (P 646)

SOUTH OF SCOTLAND ELECTRICITY BOARD
Ayrshire Area

APPLICATIONS are invited for the superannuable appointment of GENERAL ASSISTANT ENGINEER (PLANNING AND DEVELOPMENT) at Area Headquarters, Kilmarnock.

Applicants should preferably possess a National Certificate in Electrical Engineering and have some experience of high and medium voltage distribution systems and substation equipment.

The salary for the post will be in accordance with Schedule A of the National Joint Board Agreement, Clause J, Grade 14, £710/£755 per annum.

Applications should be sent to the Area Manager, Mr G. F. Moore, not later than Saturday, 23 April, 1960.

Greenholm Street,
Kilmarnock. (P 647)

CENTRAL ELECTRICITY GENERATING BOARD
Midlands Division

STATION SHIFT CONTROL ENGINEER

REQUIRED at Meaford "A" Power Station. N.J.B. service conditions, superannuable appointment salary within Schedule A of the Agreement, Grade G10, £815/£860 per annum, plus £90 shift allowance.

A sound technical training and practical experience in the control of steam generating plant and main switchgear are required. Appropriate technical qualifications an advantage.

Apply, quoting vacancy number MD 72/60 on form AE6, direct to Station Superintendent, Meaford "A" Power Station, nr. Stone, Staffs, by the 25 April, 1960. (P 645)

SOUTH OF SCOTLAND ELECTRICITY BOARD

APPLICATIONS are invited for a superannuable appointment as a HEATING AND VENTILATING ENGINEER in the Development Section of the Chief Commercial Officer's Department at Board Headquarters.

Duties will comprise the design of space heating and ventilation schemes including hot water central heating using electrode boilers and similar equipment.

Candidates should have a sound technical training in heating and ventilation. Experience in the preparation of estimates, specifications and drawings for central heating plants is required. Qualifications leading to membership of the Institution of Heating and Ventilation Engineers are desirable.

Salary: N.J.B., Clause AX/EX, Grade 5, £1,090/£1,355 per annum.

Apply, quoting reference number C2/60, on the standard form available from the Secretary, South of Scotland Electricity Board, Inverlair Ave, Glasgow S.4, not later than 29 April, 1960. (P 652)

YORKSHIRE ELECTRICITY BOARD
Head Office
ASSISTANT SECRETARY (PERSONNEL)

APPLICATIONS are invited for the post of Assistant Secretary (Personnel) at the Head Office of the Board. Candidates should have experience, preferably obtained within the Electricity Supply Industry, of the negotiation and application of agreements covering wages, salaries and conditions of service. Duties will also include responsibilities in respect of establishments, education and training, and welfare.

Salary: N.J.M. Class C. Grade 7, £2,360/£2,560 per annum.

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Secretary, Yorkshire Electricity Board, Wetherby Rd, Scarcroft, Leeds, not later than 25 April, 1960. (P 620)

CENTRAL ELECTRICITY GENERATING BOARD
South Western Division
GENERAL ASSISTANT ENGINEERS (OPERATION)
Vacancy SW/AV/45/60.

REQUIRED at Berkeley Nuclear Power Station, Gloucestershire. Superannuation Scheme.

Salary N.J.B., Class M, Grade 12, £965/£1,025 per annum, plus 10% Shift Allowance when applicable.

Applicants should hold a Higher National Certificate in Mechanical or Electrical Engineering or equivalent qualifications. Experience in modern power station operation will be an advantage.

The successful candidates will be engaged initially on plant inspection and commissioning work, subsequently transferring to reactor control duties.

Opportunity will be given for training in nuclear power techniques to fit candidates for more senior appointments.

Applications on Form AE6/ACT obtainable from the Divisional Secretary, 26 Oakfield Rd, Bristol 8, should be completed and returned by 26 April, 1960. (P 623)

EVERSHED AND VIGNOLES LTD. require young engineers of O.N.C. electrical standard for their Instrument Division Contracts Department. Expanding opportunities for advancement. Write: Personnel Manager, (Ref. 115), Cunnington St, W.4. (P 638)

TRAINEE SALES ENGINEERS
HEAVY ELECTRICAL PLANT AND RECTIFIERS
'ENGLISH ELECTRIC'
STAFFORD

Applications are invited from Electrical Engineers interested in sales work associated with the supply of heavy electrical machines, rectifiers and their associated control equipment to heavy industry.

The posts are located in technical offices at our Stafford Works dealing with customer liaison, involving correspondence and personal contact as well as the compilation of tenders and estimates.

These openings offer an opportunity to gain valuable experience of up-to-date techniques in the field of heavy industrial applications as well as offering a secure and promising career in a stable industry.

Applicants should possess H.N.C. (E).

Membership of the Staff Pension Scheme and eligibility for three weeks' holiday follow a qualifying period of service.

If you would like to visit Stafford to discuss these openings, please write giving full details to Dept. C.P.S., Marconi Hse, 336/7 Strand, London W.C.2, quoting reference ET 1297G.

(P 614)

BRUCE PEEBLES, Manufacturers of Electrical Rotating Plant, Power Transformers and Electronic Equipment, require THREE ELECTRICAL ENGINEERS for the Cardiff, Manchester and London District Offices respectively.

Applicants for these appointments should have served a recognised apprenticeship to Electrical Engineering and hold a Higher National Certificate or equivalent.

Preferred age range: 28-33 years.

Car provided after initial period. Housing assistance in approved cases.

Apply giving details of training and career to date to Divisional Director (Sales), Bruce Peebles and Co. Ltd., Edinburgh 5. Time and place of interview may be arranged to suit applicant where necessary. (P 637)

ELECTRICAL ENGINEER required in London area for the design of electrical installations in all types of buildings. Must be capable of running a project through all its phases including site supervision. Write giving full details of qualifications, experience and salary required to Box ET260, L.P.E., Romano Hse, 399/401 Strand, London W.C.2. (P 581)

ELECTRICAL ENGINEER

A Qualified Engineer required to undertake the planning of electrification schemes associated with Air Separation Plants. Should be conversant with specifications of high-tension switchgear and large machinery, etc., and be well versed in the technical supervision of contracted work. Must be prepared to travel within the U.K. and spend periods on site.

Apply:

Personnel Manager,
AIR PRODUCTS (G.B.) LTD.,
49/50 Poland Street,
LONDON, W.1.

(P 618)

ELECTRICIAN required. Young man with experience of installation, maintenance, and a working knowledge of electronics required at once. Excellent prospects. Apply in writing to Harry Vincent Ltd., Hunnington, nr. Halesowen. (P 621)

MK

M.K. ELECTRIC LIMITED

require

SENIOR DESIGNER/DRAUGHTSMEN

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THE Proprietor of Patent No. 766009 for "IMPROVEMENTS IN OR RELATING TO ELECTROMAGNETIC UNIT," desires to secure commercial exploitation by Licence or otherwise in the United Kingdom. Replies to Haseltine Lake and Co., 28 Southampton Bldgs, Chancery La, London W.C.2. (P 639)

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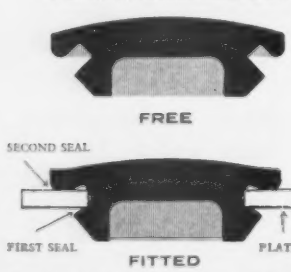

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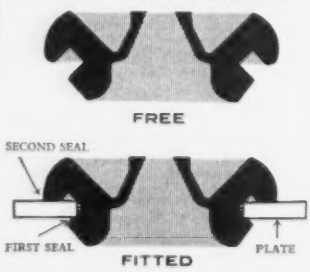

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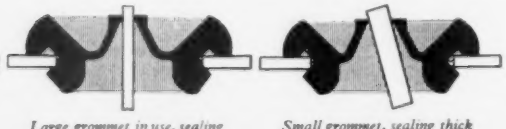

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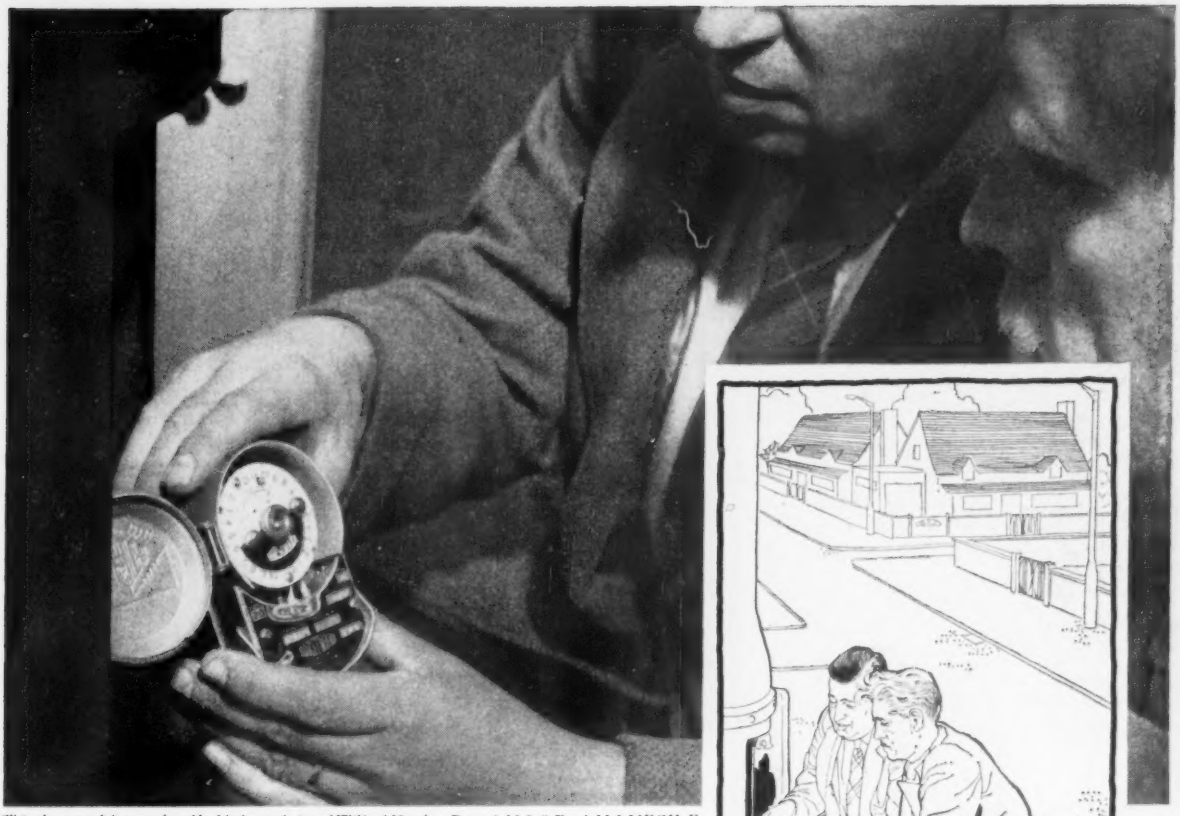

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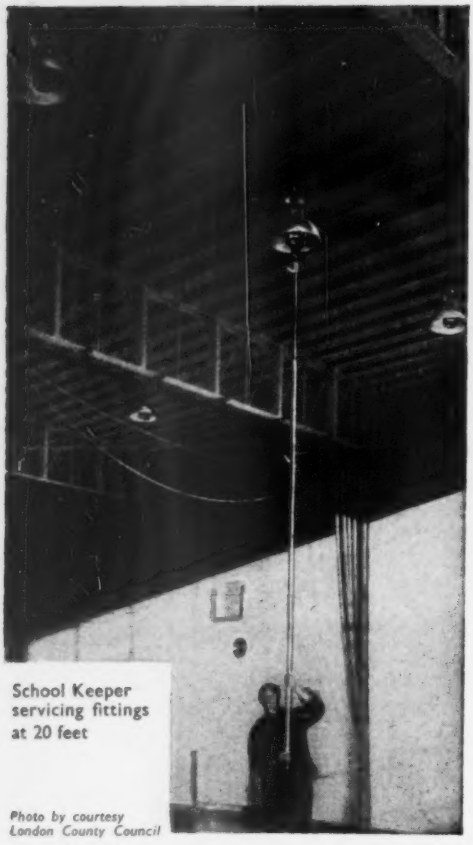

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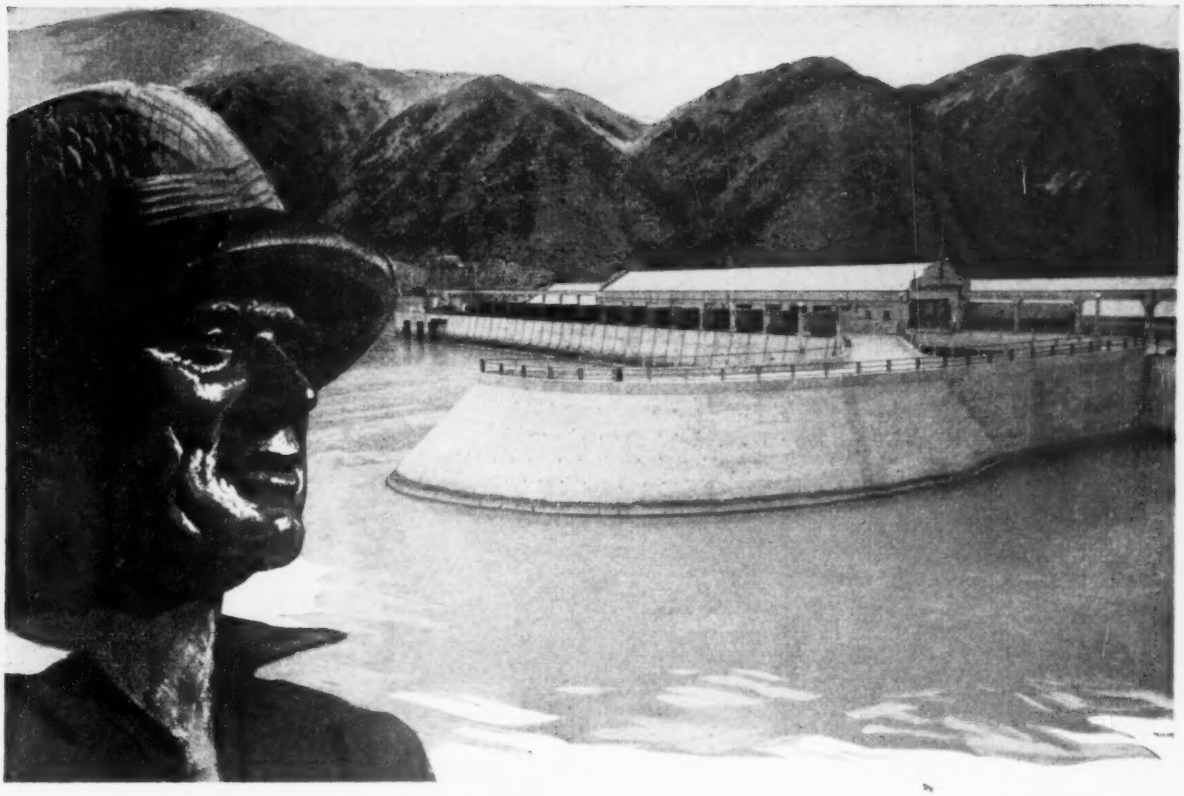

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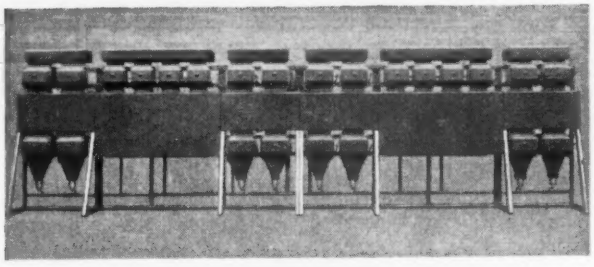

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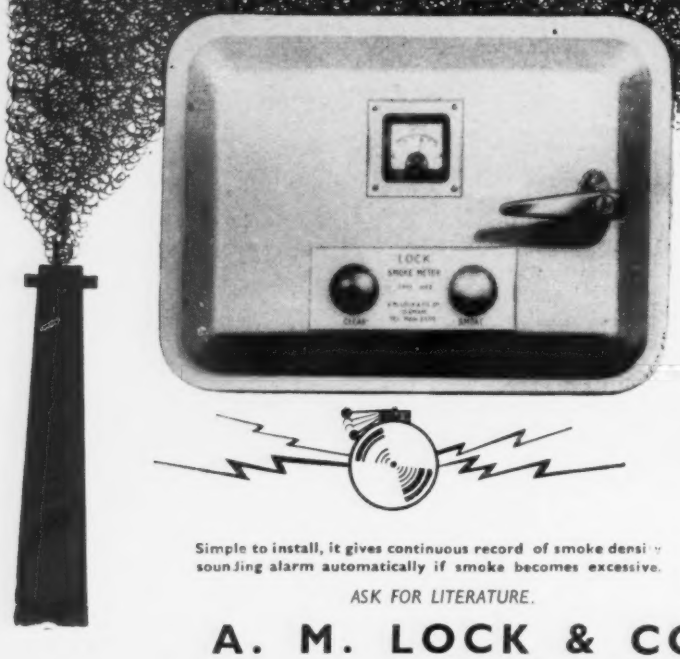

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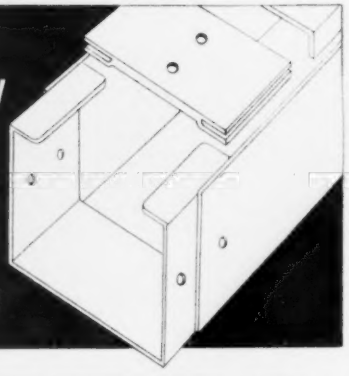

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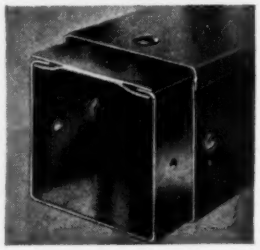

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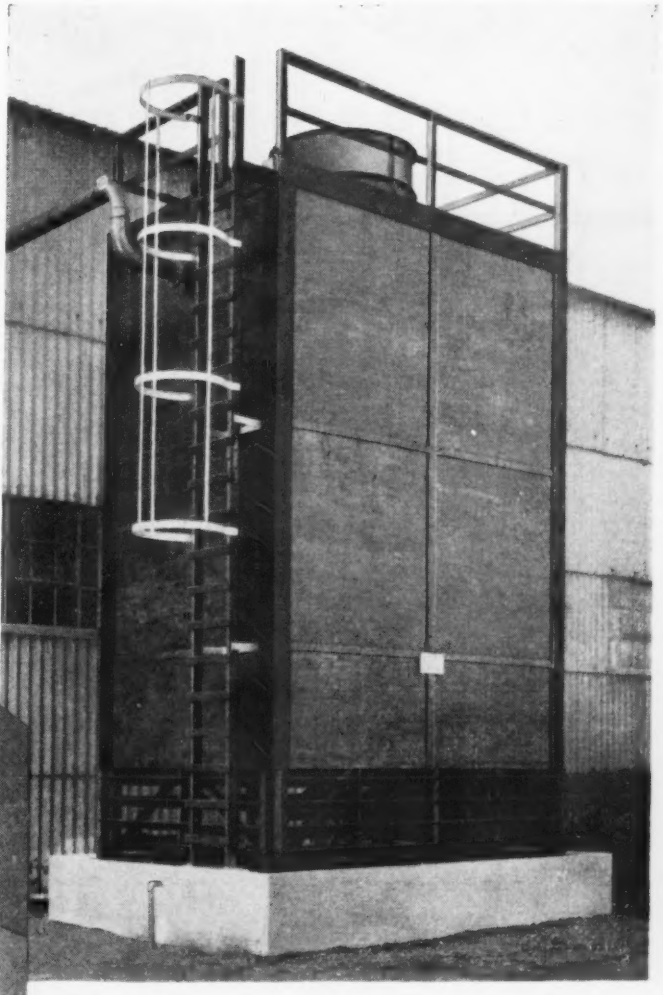

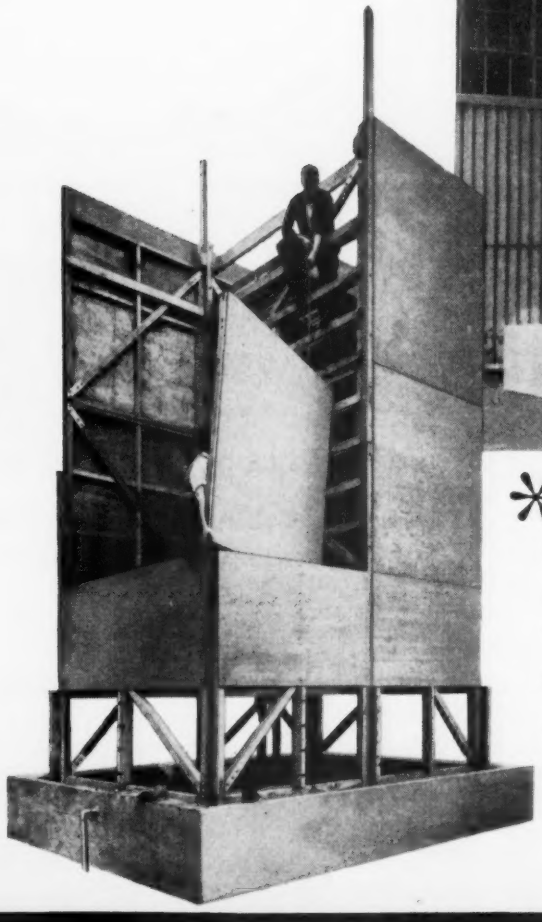

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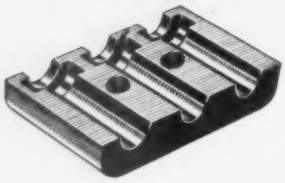
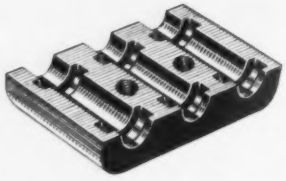
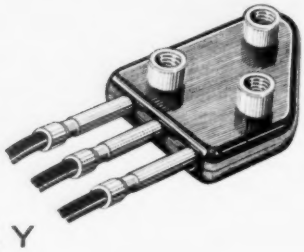

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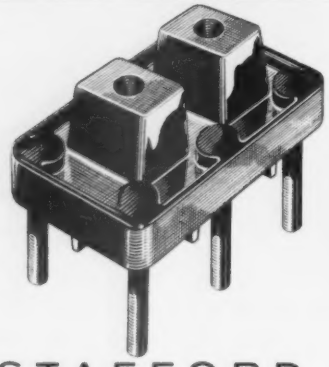
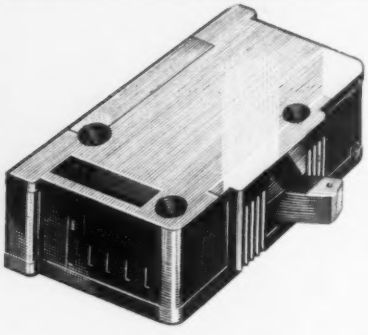

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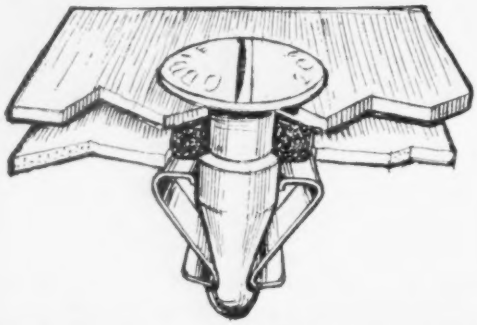

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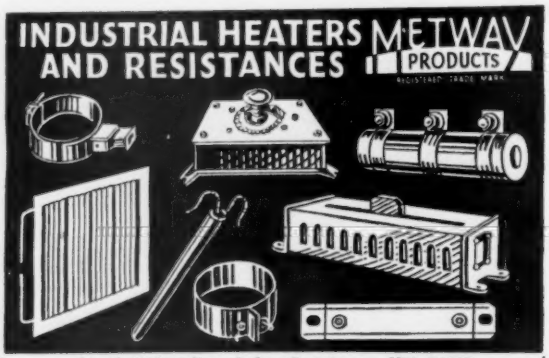

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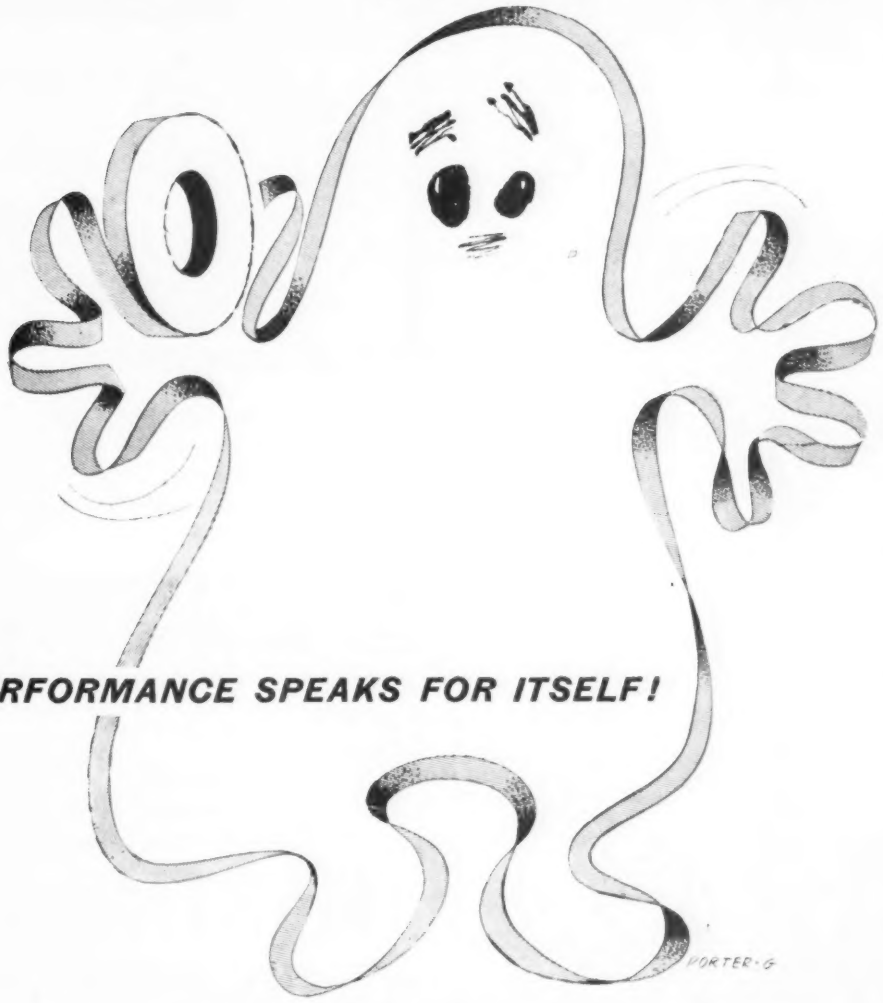

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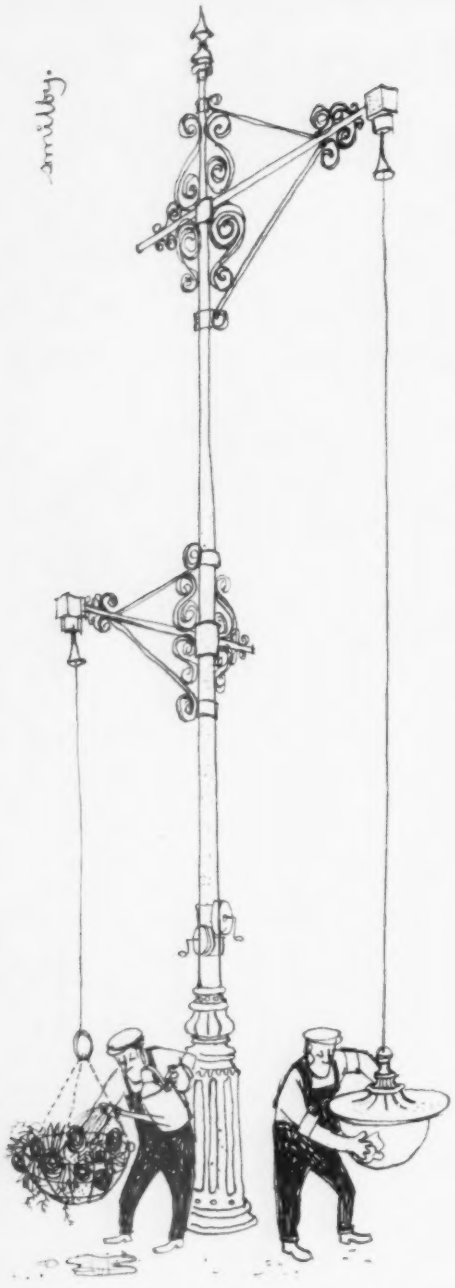

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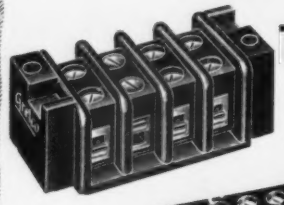

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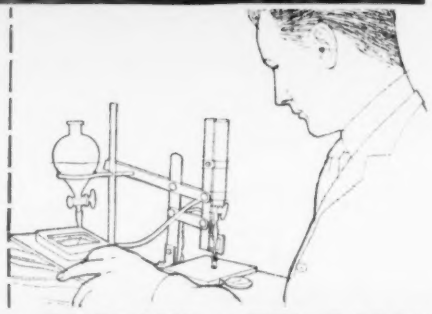

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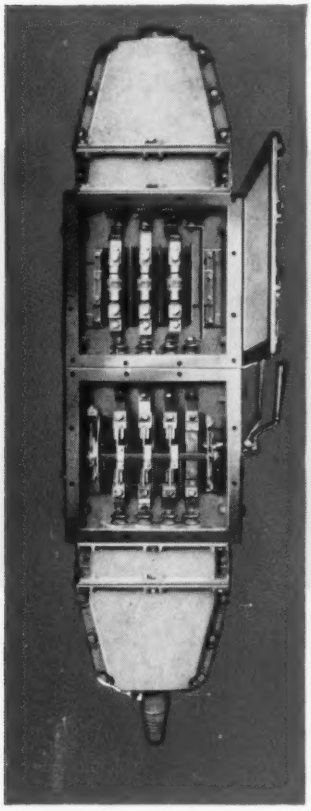

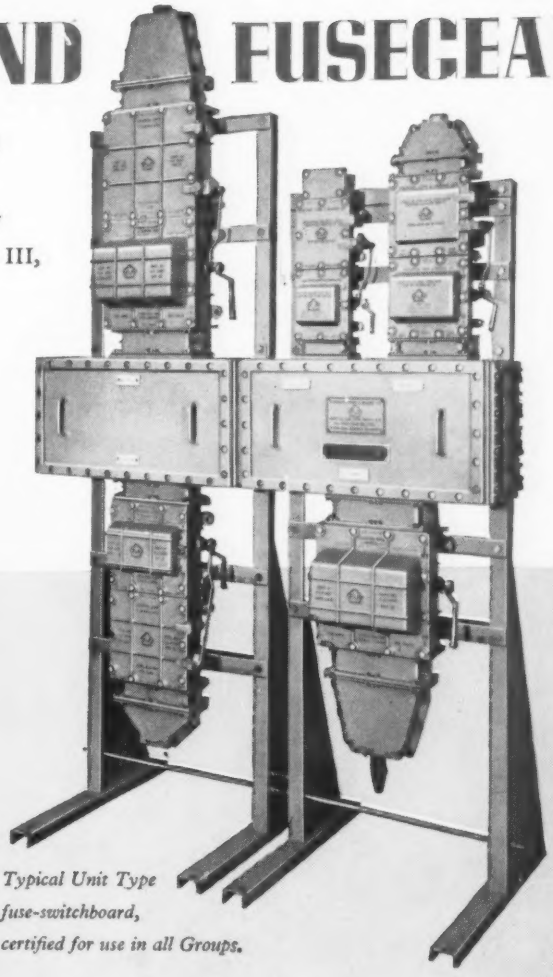

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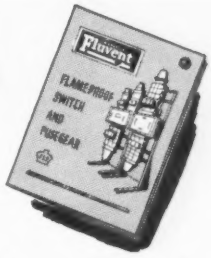

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